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LIVES
OF
GAME ANIMALS
Volume IV — Part II

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LIVES

OF

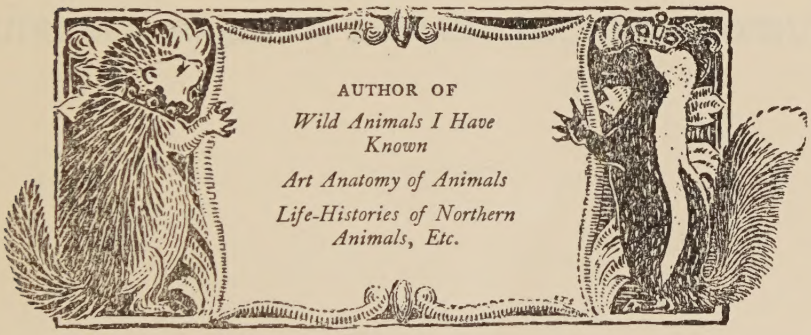
GAME ANIMALS

An Account of those Land Animals in America, north of the Mexican Border, which are considered "Game," either because they have held the Attention of Sportsmen, or received the Protection of Law.

BY

ERNEST THOMPSON SETON

FELLOW NEW YORK ZOOLOGICAL SOCIETY
MEMBER NAT. INST. ARTS AND LETTERS



WITH 50 MAPS AND 1500 ILLUSTRATIONS
BY THE AUTHOR

VOLUME IV — PART II

RODENTS, ETC.

GARDEN CITY NEW YORK
DOUBLEDAY, DORAN & COMPANY, INC.
1929

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PRINTED IN THE UNITED STATES
AT
THE COUNTRY LIFE PRESS, GARDEN CITY, N. Y.

LIVES
OF
GAME ANIMALS

Volume IV — Part II

Order Rodentia, etc.

SQUIRRELS, RABBITS, ARMADILLO, AND OPOSSUM

LIFE LXXXV—THE BEAVER

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Beaver using his Tail as a Trowel

Canadian Beaver, American Beaver

Castor canadensis Kuhl

(L. *Castor*, a Beaver; L. *canadensis*, of Canada)

Castor canadensis KUHL, 1820, Beiträge z. Zool., p. 64.

TYPE LOCALITY—Hudson Bay

FRENCH CANADIAN, *le Castor.*
CREE, *Ah-misk'.*
OJIBWAY, *Ah-mik'.*
CHIPEWYAN, *Tsa.*
YANKTON SIOUX, *Tcha-pá.*
OGALLALA SIOUX, *Chan-pah'.*

The Family *Castoridæ* contains but one genus, *Castor* (Linnæus, 1758); the animals in this, are very large rodents of aquatic habits. They have a massive skull of general squirrel type; short ears; 5 toes on each foot; the hind foot webbed; the claw of second toe on hind foot is double (possibly for use as a comb and louse-trap); tail, broad, flat horizontally, and scaly; the incisors, of a deep, orange colour.

$$\text{Teeth: Inc. } \frac{1-1}{1-1}\text{; prem. } \frac{1-1}{1-1}\text{; mol. } \frac{3-3}{3-3} = 20$$

When alive, the Beaver looks like a huge Muskrat; but the broad, flattened tail is a distinctive mark at all ages.

Dugmore says: "Outwardly, there is nothing to distinguish the sexes, except when the female is suckling her young; then her 4 teats, which are situated between the forelegs, are slightly enlarged."[1] Richardson says: "The female has 8 teats."[2] But C. E. Johnson says "4 is normal."

In addition to the generic characters, the Canadian Beaver has:

Size. Length, 43 in. (1092 mm.); tail, 16 in. (406 mm.); of which the scaly part is 9 in. (229 mm.) long, and 4½ in. (115 mm.) wide; hind foot, 7 in. (177 mm.).

[1]Romance, p. 213.

[2]F. B. A., I, p. 107.

Weight. A male which I got near Great Slave River, July 11, 1907, weighed 30 lbs.; this was considered of fair size.

William H. Blackburne, of the Washington Zoo, tells me that, about 1904, he received 10 Beavers, captured alive in Yellowstone Park by T. Elwood Hofer. Of these, the heaviest was 56 lbs.; another was 42 lbs.; the rest ran from 34 to 38 lbs., and were probably two-year-olds.

At Winnipeg, in 1886, I saw one weighed at 54 lbs.; this was taken at Brokenhead, Man. Although Bachman gives[3] 61 lbs. as a maximum, W. R. Hine tells me that he weighed a 68-lb. Beaver that came from Port Arthur, Ont.

"Old and large Beavers reach a weight of 60 to 70 pounds; and there are records of old and very fat Beavers weighing from 100 to 110 pounds."[4]

Colour. The general colour is a deep, dark chestnut; darker on the ears; paler and grayer below; the cheeks, pale brown, in contrast with the crown; the region above and at each side of the tail, cinnamon rufous or bright chestnut.

The sexes are alike in colour.

Colour Freaks. Both black and white freaks are found. The black pelts are worth about double the common ones; the white ones have no especial value.

"Black Beaver," says Hearne, "and that of a beautiful gloss, are not uncommon; perhaps they are more plentiful at Churchill than at any other Factory in the Bay; but it is rare to get more than 12 or 15 of their skins in the course of one year's trade."[5]

The Canadian Beaver differs from that of Europe chiefly in being much larger, and in having shorter nasal bones. Those bones in the European measure *considerably more than one-third* the distance between the incisors and the occipital crest, and in the Canadian *about one-third.*

Races

The following races of *canadensis* are recognized:

canadensis Kuhl, the typical form. T. l., Hudson Bay.

carolinensis Rhoads, larger than the type, with broader tail. T. l., near Danbury, Stokes Co., N. C.

frondator Mearns, larger and paler than the type, with scaly part of tail shorter than twice the width. T. l., San Pedro River, Sonora, Mex.

---

[3] Q. N. A., I, p. 353.

[4] V. Bailey, Beaver Farming, p. 4.

[5] Journey, p. 241.

leucodonta Gray, largest and (except phæus) darkest of all, with scaly part of tail longer than twice the width. T. l., Vancouver Id., B. C.

texensis Bailey, very large and pale, with scaly part of tail longer than twice the width. T. l., Cummings Creek, Colorado Co., Tex.

shastensis Taylor, much like *subauratus*, with broader interparietals, and other cranial differences. T. l. Cassell, Pitt River, Calif.

subauratus Taylor, a large form, lighter in colour than *leucodonta*, but not so light as *frondator;* with a golden sheen over the body. T. l., Grayson, Stanislaus Co., Calif.

missouriensis Bailey, slightly smaller than *canadensis;* much paler and duller brown, and with skull less massive; duller and darker than *mexicanus;* not so rusty as *frondator*. T. l., 7 miles east of Bismarck, N. D.

belugæ Taylor, like *leucodonta*, but paler; pelage thicker, also with cranial distinctions. T. l., Beluga River, Cook's Inlet, Alaska.

mexicanus Bailey, brighter and lighter than *missouriensis*. T. l., 6 miles below Ruidoso, Lincoln Co., N. M.

michiganensis Bailey, size medium or small; colours very dark; ears and feet black; skull short and quadrate. T. l., Tahquamenaw River, Luce Co., Mich.

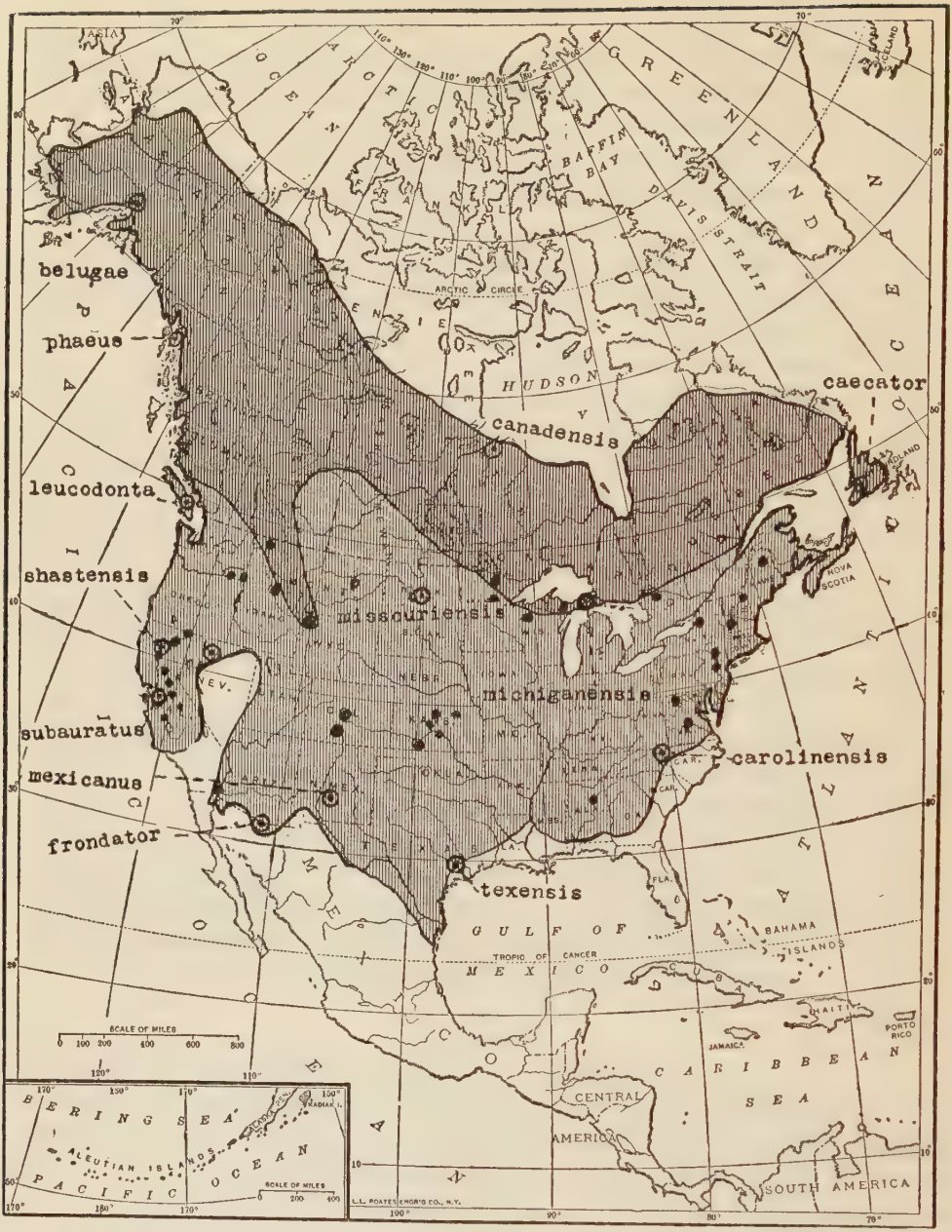
phaeus Heller, colour above, dark seal-brown; very much darker than *leucodonta*. T. l., Pleasant Bay, Admiralty Id., Alaska.

caecator Bangs, like *canadensis*, but slightly smaller, and with cranial differences; incisors yellow instead of orange. T. l. near Bay St. George, Newfoundland.

Primitive Range and in 1910

Map XIII (page 446) shows that the Beaver ranged over all temperate America, wherever there was wood with water. Nevertheless, it abounded chiefly in those areas where the aspen, its favourite food, was found in abundance.

In 1900, after four centuries of unrestricted and wholesale slaughter, there were great blank spaces on this Map. In practically all of the United States, the Beaver were killed off. A few small regions still held a remnant; among these were Maine, Minnesota, and the Rockies in Wyoming, Montana, and Idaho.



MAP XIII.—RANGE OF THE BEAVER

By E. T. Seton, with assistance of the Biological Survey, 1927

The original range is the tinted area. In Canada and Alaska, it is still of general distribution, as indicated by heavy shading, excepting on the Ontario Peninsula, and the prairie region of Manitoba, Saskatchewan, and Alberta.

In the United States, it is extirpated except in a few scattering remnants. Those known as exact records in 1925 are entered as dots on the map of the U. S.

Beaver, thus virtually restricted to Canada, were found sparsely over all the ancient range there, excepting on the Ontario Peninsula.

W. Couper holds that Beaver never were found in Anticosti.[6]

Primitive Numbers

Harry V. Radford, after much investigation, set the primitive Beaver population of the Adirondacks at 1,000,000, or about 60 to the square mile. The Adirondacks is about one four-hundredth of the total range, and was choice region. Vast areas, like the Mississippi Valley, were so poorly peopled that the figures might be divided by 10. So that these data imply a pristine population of 400,000,000.

Approaching the question in another way: In the late '50's, L. H. Morgan explored thoroughly a Beaver country on the southwest shore of Lake Superior, immediately west of Marquette; it was 6 by 8 miles. In his map[7] of this, he shows 63 dams and 39 lodges. Each lodge was estimated to represent 7 Beaver; that is, 273 in all, or $5\frac{2}{3}$ to the square mile. But he mentions that not all of the lodges are shown on the map. A reading of the text leads us to believe that there were twice as many as marked; so that his ratio may have been 10 to the square mile. Any of us that are familiar with Beaver country, know that 20 to the square mile would not have been an overestimate in such surroundings.

In Cochetopa National Forest, the Beavers have been computed at 12,000. The Forest is 1,400 square miles. This gives over 8 to the square mile; but we are told that but half of the productive area is in use;[8] which would raise the rate to 16 per square mile.

The Plains were less attractive to the Beaver than the mountains, and the Mississippi Valley no better than the Plains. On the other hand, the great poplar country of the North teemed with Beaver; and the ratio supplied by Morgan's data of 10 to the square mile in Minnesota, may easily have held as average, on the greater part of the range. That range was about 6,000,000 square miles, so that 60,000,000 may have been the primitive Beaver population in years of abundance.

That these figures are not too high, is shown by the Beavers in Algonquin Park, Ont., which comprises nearly 2,000 square miles. Dr. T. S. Palmer tells me that the Beaver there are estimated at 100,000, or 50 to the square mile. This represents maximum abundance.

---

[6] Forest & Stream, June, 14, 1877, p. 300.

[7] Am. Beaver, p. 82.

[8] Adirondack Beaver, p. 168.

But, supposing such conditions prevailed on only one quarter of the Beaver range, it would imply a total population of about 100,000,000 Beaver. I, therefore, hold that the above 60,000,000 estimate is a safe and conservative computation of the population in primitive times.

Haunts and Home Range

Sluggish streams and small lakes with clay banks that are well wooded with aspen and willow are the favourite haunts of the Beaver. Streams that run in rocky beds, or that dry up in summer, and large rock-bound lakes are equally shunned.

The individual range is very small for so large an animal. When the pair have found and settled in a place that suits them, they do not travel half a mile from home. When, on the other hand, an unmated Beaver is seeking a partner or a good location, he may wander for a dozen miles.

During the summer, the old males and the weanlings often leave the mother and kits on the home pond, and go on a camping trip that may last all summer, and take them 20 miles away. But all return to the central lodge in early autumn.

At the Big Dam Lake, 40 miles east of Kippewa, Que., on Sept. 21, 1905, I saw much Beaver work, and learned from Mittigwab, the Indian guide, that all of this was the work of one old male Beaver that had lived here alone for two or three years. He wandered as much as 15 miles up stream from the Lake, and 1½ miles from water, in search of company, especially in early spring when the ice first breaks up.

The Old-time Trapper

Some idea of the vast numbers of the Beaver may be gathered from the following records:

In 1825, James O. Pattie, trapping on the San Francisco River of Arizona, caught 250 Beaver in two weeks.[9]

Alexander Ross, in his "Fur Hunters of the Far West," (1855) says of the trapping on the Continental Divide that is in the Bitterroot Mts., between the Missouri and Columbia Rivers: "While in the last defile, we took 95 Beaver in one morning, and 60 more during the same day."[10] In summary, he states that he had 212 Beaver traps, and that at the close of the season (1823–24), "our returns were the most profitable ever brought from the Snake country in one year, amounting to 5,000 Beaver, exclusive of

[9] Personal Narrative, 1905 ed., p. 56.

[10] Vol. II, p. 53.

other peltries."[11] That is to say, his 20 trappers averaged 250 Beaver each, in spite of continual trouble with the Indians.

In 1850, Audubon and Bachman wrote of the Rocky Mountain trapping: "A good trapper used to catch about 80 Beavers in the autumn, 60 or 70 in the spring, and upwards of 300 in the summer in the mountains; taking occasionally as many as 500 in one year. . . . If a trapper now secures 100 in the winter and spring hunt, he is considered fortunate."[12]

George P. Belden, who lived with the Sioux in the '60's, says: "A trap weighs about 5 pounds, and it is considered a good load to carry 12. It will require a walk of 10 or 12 miles, and all of one day, to set a dozen traps properly. If 3 Beavers are caught each night for every dozen traps set, the trapper considers he is doing a good business. . . . During the winter season, the hunter will average not over 4 Beavers per week, for there are many days he cannot trap."[13]

Henry Bannon, in his "Beaver Days," says: "A trapper with 25 traps on his line, must make his rounds; must reset sprung traps, and must establish new locations. Two Beaver a day from such a line is an excellent average."[14]

Something like a restoration of primitive conditions is noted in the official report of Beaver in Cochetopa National Forest. Here, after some years of protection, the Beaver have increased to 12,000 on the 1,400 square miles of the Forest; that is, over 8 to the square mile. Here, in one month, one Government trapper, with 20 traps, caught 132 Beavers.[15]

At one time the last quarter of the 18th Century—about 150,000 skins were exported annually by the American companies, besides which the Hudson's Bay Company marketed about 50,000 per annum.

In 1891, the American supply had dwindled to 11,693, and the Hudson's Bay Company's was 57,260—a bad year for the Company, as in 1887, its export had been 102,745, and in 1871, had reached 174,461.

In 1924, the total catch in Canada was 169,172 pelts, with probably enough in Alaska and the United States to make the round 200,000. It is very doubtful whether they can stand such a drain.

In 1905, the latest year for which I have complete figures, the Hudson's Bay Company's returns were 54,119.

At the London annual fur sales held at Lampson's (March, 1906), 8,414 Beaver were sold. The highest price reached was 62 shillings ($14.88)

[11] Vol. II, pp. 140–41.

[12] Q. N. A., I, p. 354.

[13] Belden, the White Chief, 1872, p. 136.

[14] Days, p. 513.

[15] Smith Riley, Journ. Mamm., Nov., 1921, p. 201.

each, for 41 first-class black skins; 30 shillings ($7.20) to 35 shillings ($8.40) were ruling prices for first-class skins, from which they graded down to about 15 shillings ($3.60) for thirds.

During the great fur boom of 1920, the average price paid for Beaver was $16.31. The record price was $100.

The average annual total of Beaver skins brought out by the American fur companies and the Hudson's Bay Company for the period between 1860 and 1870, when the fur trade was at its height, is, in round numbers, 153,000. But the natives used as many good pelts as they sold, and seldom saved the skins of those taken in summer, though they killed for food the whole year round. So that 500,000 per annum is more likely to represent the aggregate destruction by man. This was at least doubled by other agencies. and the total annual death rate would reach not less than 1,000,000.

Present Numbers in British North America

The tremendous slaughter of the Beaver through the general use of steel traps and modern guns, combined with the reduction of the range by clearings, brought the usual change. The species disappeared from the immediate Mississippi Valley and all the Eastern States except Maine. The southern parts of Quebec, Ontario, Manitoba, Saskatchewan, and Alberta were wholly cleared of Beaver. The low dip of the curve was the dark time about or right after 1895; perhaps 1900 was the blackest year of all.

Then came the awakening, which took the practical form of protective laws, sanctuaries, and implantations.

Summary of Recent Reports

Newfoundland. The Beaver here was reduced to a remnant in 1900; but, thanks to a protective law, they are slowly increasing. Dugmore says that during his visits to the Island in 1901–05, he "*never saw but one Beaver colony*, and that, a very small one in a remote and inaccessible part of the country. In 1912, I counted no less than 27 occupied lodges within a short day of walking and canoeing."[16]

Quebec. Rapidly recovering.

Ontario. Recovering. The Algonquin Park had but a remnant 25 years ago; now (1922) it is believed to carry 100,000 Beavers—which are overflowing and restocking the adjoining country.

Manitoba. In 1900, the Beaver was practically extinct; but in 1924, according to George H. Measham, of the Winnipeg *Tribune*, 5,000 pelts were marketed, and there were plenty of Beaver left for seed.

[16] Romance, p. 159.

From *Saskatchewan*, *Alberta*, and *British Columbia* also come encouraging reports.

The official returns of Beaver pelts taken in Canada during the seasons 1920–21 to 1923–24, are 164,656; 232,134; 175,275; 169,172. Allowing for kits, poor skins, local absorption, and free traders' furs, these figures imply a destruction of 300,000 a year in Canada; and, because the stock increases, it indicates a total of at least 1,500,000 Beaver in the Dominion to-day.

Conditions in the United States

The wipe-out was more nearly complete in the United States. The scattered fugitives in the remote swamps of the Northwest and the Rockies were shyer than ever before. They never appeared in daylight; and but for their dams, might have eluded notice.

New York. The first notable restoration was in the Adirondacks, where, in 1904, under management of Harry V. Radford, 6 Beavers were introduced; other implantations (35 Beaver in all) were made later.[17]

In 1908, these, with a possible dozen of the original population, had increased to 150. In 1920, according to Dr. C. E. Johnson, they had reached 8,000.[18] In 1924, an open season was declared, and about 5,000 pelts taken. In 1925, the same law and results were repeated. So that, in 1926, the number of Beaver in the Aidrondacks was probably not more than 10,000.

Sullivan Co., N. Y. Ambrose Monell planted 8 Beaver in Bushkill on his estate. This was in May, 1914. They are thriving, and spreading,[19] and are now estimated at 100.

Vermont. An implantation of 6 was made at Stamford, Bennington Co., in 1921.[20]

New Hampshire. "Two colonies in the northern part of Coos Co."[21]

Maine. Generally distributed, but rare; increasing under protection.

New Jersey. About 1900, some Beaver on Rutherford Stuyvesant's Game Preserve at Allamuchy, N. J., escaped, and have spread over parts of Sussex Co.[22]

Pennsylvania. In Monroe Co., after being totally extirpated for 50 years, Beaver reappeared in 1901. They are being carefully protected.[23]

[17] See N. Y. S. F. F. & G. Comm., 12th Ann. Rep., 1907, p. 41.

[18] Adir. Beaver, p. 165.

[19] N. Y. Zool. Soc. Bull., Nov., 1915, p. 1296.

[20] George L. Kirk, Journ. Mamm., Feb., 1923, pp. 59–60.

[21] C. F. Jackson, Journ. Mamm., Feb., 1922, p. 15.

[22] S. N. Rhoads, Mamm. Pa. & N. J., 1903, pp. 76–77.

[23] As above, p. 70.

John J. Slautterback, of the Game Commission, writes me (Dec. 14, 1926) that about 30 counties of Pennsylvania now have Beaver colonies—at least 150 colonies in all. This, I take it, means not less than 3,000 Beaver in the State.

Virginia. In *Forest & Stream* for March, 1915, p. 229, is an interesting statement by T. Peter Howle, of Richmond, Va., that a colony of Beaver has appeared in the upper part of the James River, after a 50 years' blank.

West Virginia. A colony of immigrants appeared in the fall of 1922 at Tear Coat Creek, an affluent of the North River.[24]

Kansas. Although wholly gone in 1900, Beaver have reappeared on Blue, Solomon, Smoky Hill, Mulberry, and Arkansas rivers.[25]

Minnesota. In Itasca Park, a few Beaver were found in 1900; elsewhere in the State, there were none, except a scarce remnant in Lake, Cook, Beltrami, Koochiching, and St. Louis counties. Protection and restocking began. In 1924 not less than 1,200 were in the Park.[26] They are also numerous now in Lake Co.[27]

In the northern tier of States, west of Minnesota, a few Beaver managed to hold out till 1900; then, in the awakening, they increased.

Wyoming. In Yellowstone Park, according to a recent letter from E. J. Sawyer, "800 would be a reasonable estimate of the present Beaver population."

Washington. Common now and troublesome in the southeast corner of the State.[28]

Oregon. "Oregon has already obtained marked success in starting new colonies in different parts of that State."[29]

California. New colonies possessing the desolated ranges are reported from Modoc Co.,[30] Sacramento, San Joaquin, Pitt, Merced, Tuolumne, and Stanislaus rivers.[31]

About "100 Beavers in the Imperial Valley."[32] Since protection, they have "increased greatly."[33]

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[24] A. B. Brooks, Journ. Mamm., Aug., 1923, p. 191.

[25] N. Y. Zool. Soc. Bull., May, 1924, p. 71.

[26] Hunter-Trader-Trapper, Nov., 1924, p. 33.

[27] C. E. Johnson, Journ. Mamm., Feb., 1922, p. 36.

[28] L. R. Dice, Journ. Mamm., Nov., 1919, p. 19.

[29] Cal. F. & G., Oct., 1915, p. 222.

[30] As above, July, 1916, p. 163.

[31] W. P. Taylor, Conservation of Native Fauna, Scientific Monthly, Oct., 1916, p. 401.

[32] J. Dixon, Journ. Mamm., Aug., 1922, p. 140.

[33] H. C. Bryant, Cal. F. & G., Oct., 1915, p. 236.

Estimated Numbers in U. S. and Alaska

From the annual report of the Forester[34] for the year ending June 30, 1926, I quote the following statistics of Beaver in the National Forests, by actual census of Dec. 31, 1925.

Arizona	185	
California	271	
Colorado	47,314	
Idaho	12,208	
Minnesota	2,708	
Montana	15,383	
New Hampshire	180	
Nevada	662	
Oregon	5,849	
So. Dakota	2,176	
Utah	9,687	
Washington	11,138	
Wyoming	6,563	
Total		114,324
Add half as many more outside of the Forests, but protected by State laws		57,162
Add to this, the States not listed. These are estimated as follows:		
Kansas	100	
Maine	5,000	
Michigan	2,000	
New Jersey	100	
New York	10,000	
No. Dakota	2,000	
Pennsylvania	3,000	
Vermont	100	
Virginia	10	
West Virginia	10	
Wisconsin	100	
Total		22,420
Alaska		50,000
Scattering in these and other States		8,094
Total in U. S. and Alaska		252,000

[34] U. S. Dept. Agri., p. 37.

Commenting on the figures above, Will C. Barnes says:[35] "The Service estimates that, in addition to the number of Beaver in the National Forests, probably half as many more are to be found on streams outside the National Forests where they have been protected by State laws." This proportion is added in the census above.

Material Contributions

This animal has always been a staple of food and raiment to the natives of America. Its wonderful coat of fur is prime for half of the year, it is backed by a very strong skin, and is one of the peltries most highly prized.

The skin of its tail has provided ornamental leather for pouches and purses; and there is always a possibility that, in the description given later, of its split toenail, our settlement workers may be inspired to discover a new and comforting suggestion. (See Section on Parasites.)

As a food supply, the Beaver takes a prominent place. The flesh is good, and the tail is considered a delicacy. In taste, it is like calf's head with marrow dressing, is decidedly rich and heavy, but I found it delicious eating.

Richardson says: "The flesh of the Beaver is much prized by the Indians and Canadian Voyagers, especially when it is roasted in the skin, after the hair has been singed off. In some districts, it requires all the influence of the Fur Trader to restrain the hunters from sacrificing a considerable quantity of Beaver fur every year, to secure the enjoyment of this luxury; and Indians of note have generally one or two feasts in a season, wherein a roasted Beaver is the prime dish."[36]

In a vast portion of the Mackenzie Valley, the Beaver serves the Indians as the Buffalo did those of the Plains. It is their staff of life, it feeds and clothes them, as well as supplies the necessary peltry to barter with traders for other things desired. These tribes are very naturally known as the "Beaver Indians."

Beaver Farming

With the choice Beaver pelts fetching as high as $100 apiece during the great fur boom of 1920, one is not surprised to hear of many attempts at Beaver farming. In general, one may say that, so far, no one has made a success of it when tried on a small scale, such as a 50-acre plot; and that no one has made a failure of it when tried on a large scale, such as 1,000 square miles, with adequate protection.

Illustrations in point are the Cochetopa Forest, 1,400 square miles,

[35] Personal letter, Dec. 16, 1926.

[36] F. B. A., I, pp. 106–107.

PLATE LIII.—FAMILY OF BEAVERS

(*Castor canadensis* Kuhl)

The pair in the water are having a friendly nibbling match

now carrying 12,000 Beaver, rapidly increasing; the State Forest Reserve in the Adirondacks (chiefly in Herkimer and Hamilton counties), 3,200 square miles, with 10,000 Beaver, rapidly increasing; and the Algonquin Park, 2,000 square miles, with 100,000 Beaver, which might easily yield a Beaver crop of 10,000 per annum.

Here, the wide-awake Canadian Government has proceeded to demonstrate the possibilities of Beaver ranching. The pelts, on an average, are worth $15, according to present markets; and the excellent meat, hitherto wasted, is now being sold.

In *Field & Stream*,[37] we learn that "the provincial government of Ottawa shipped 600 Beaver from Algonquin Park to the civic abattoir at Toronto, where they were dressed and distributed to retail dealers for the Easter trade. They sold at 18½ cents per pound for a half carcass, and 17½ cents for the whole carcass."

Dams and Damage

An unexpected jolt has been given the whole plan of Beaver restoration by the complaints of land and timber owners in the Adirondacks.

In *Field & Stream*[38] is given a summary of the Ranger's Report on Beaver dams in the Adirondack Forest Preserve, as follows:

Total number of dams reported	587
Total area flooded	8,681 acres
Total value of timber drowned	$51,425
Possible salvage of timber	$ 5,530
Average damage per dam	$ 90

Other charges against the Beaver are that it builds ponds that harbour pickerel, now prey on trout; it floods the marshes that once furnished winter forage for Deer; it comes up on private lawns and cuts down the choicest shade trees.

The answers are: The damage done by flooding is temporary; once a balance is established and a fair population provided for, flooding will cease.

Next, by conserving the water supply, the Beaver keeps little brooks running all year, instead of only during freshets, so that the forest is helped by irrigation. Its ponds provide valuable fireguards, far offsetting the timber damage by the flooding. It makes trout streams of many rills that were mere drains.

[37] Aug., 1918, p. 330.

[38] Nov., 1919, p. 386.

PLATE LIV.—FEET OF ADULT MALE BEAVER (LEFT SIDE), TAKEN NEAR FORT RESOLUTION, M. T., JULY 11, 1907.

Eleven-twelfths of life size. The figure in the right upper corner is the split nail of the second toe on hind foot; it is twice natural size

Marsh grass is not the winter forage of Deer; they prefer twigs. Private laws are easily protected with a low wire fence; and in all cases, the Beaver prefers quaking aspen, which is never planted as an ornamental tree.

Finally, it is a valuable animal, economically considered. The Adirondac Beaver, properly handled, may be, not merely a joy to the people who see them, but an annual profit of $100,000 to the State.

His Tools

Teeth. The four bright orange incisors of the Beaver are his chief tools in the battle of life. He could live without his tail, or his paws, or his hind feet—yes, even without his eyes. But without his four yellow wood-choppers, he would die in a week. With these, he stands on the highest pinnacle in the scale of rodents—the top of the pyramid on which these creatures might be exhibited in rising order of rodentation.

The fact that the incisors have persistent, fast-growing pulps, is emphasized in the following by Henry Braithwaite, who says: "One of the queerest facts about the Beaver is the rapidity with which his long, chisel-shaped teeth will recover from an injury. I have known Beavers to break their teeth in biting a trap; and when I caught them again ten days afterwards, you couldn't see a sign of the break—the teeth had grown out to their former perfection in that short period."[39]

An inevitable suite of such continuous growth is seen in cases where the Beaver breaks off one tooth so that its opposite has no counter-grind. It continues growing till it forms an arc, disabling and finally killing its unlucky owner. This curious accident has been recorded for many rodents.

Double Claw. The extraordinary double or combing claw that is found on the second toe of the hind foot is more fully discussed in the section on Lice and Louse-trap (p. 494).

Fore paws. Next to the four orange-yellow, self-sharpening wood-axes that he carries in his mouth, the important tools of the Beaver are his fore paws. Those marvellous little hands of his are the world's standard of indefatigable industry. Every gob of mud, every stick and stone in the dam or the lodge, is moved by those small hands. Sticks are held in them while being cut up by the teeth; mud and stones are clutched in them, against his throat or shoulder, to be transported; the Beaver pushes, pulls, digs, and grapples with them, scratches his back, combs his hair—uses them in all senses, indeed, as hands.

Long sticks are carried in the teeth, with the end over the Beaver's

[39] Habits, p. 2.

back, if on land. Small logs are rolled by one or more Beavers, pushing with their hands, their shoulders, their hips, or their whole broadside.

Tail. At one time, inspired by the shape of the member, currency was given to an idea that the Beaver used his tail for a trowel. Circumstantial proof was found in the facts that loud slaps were heard, which certainly were made by the Beaver's tail; and impressions of the tail were sometimes seen in the new-laid mud. These, however, were easily explained away, and a rigid ruling made that Beaver do use the tail for swimming and signalling, but for nothing more.

A rigid ruling is always a challenge. The Beavers and the Beaver-men took it up. First, Josef Brunner not only sees, but secures a photograph of a Beaver actually carrying a bundle of food-wood across his tail, which was curled up high to hold it.[40] The accompanying article contains the following: "In handling the mud, however, the Beaver makes a pile with his front feet, turns around, forces his tail sideways into it, and then lifts this so that the load rests partly on it and partly on his back."[41]

Next, Major William A. Welch, of Interstate Park, N. Y., writes of the Beaver in his care.[42] "The other evening, I watched at Nawauhunta a Beaver come to the shore of the lake; and, with his teeth and his front feet, dig out about an ordinary spadeful of mud and grass roots from the edge of the bank. He drew this mud and grass roots out into the lake, where it was just covered with water, and then turned around and put his tail under the whole thing, just as you would a spoon, bent up the end of his tail to hold it on, and swam about 25 yards with this shovelful of mud on his tail, over to the dam, and placed it on the dam. He then drew his tail from under it, turned around, and started to put it into shape."

Finally, at Winnipeg, in the October of 1924, I myself succeeded in photographing a Beaver in the act of carrying some gravel on his tail. (Plate LXI p. 494) It was not much, but enough to serve as a warning against hard-and-fast rules, too readily proclaimed.

Cutting Down Trees

The first original thing that the Beaver did, after he really became a Beaver, was to cut down a tree. This is one of the most amazing performances of the species; so, of course, it was much exaggerated in early accounts. Thus, the statement that the Beaver is so skilful that he can always throw

[40] Country Life, April, 1904.

[41] P. 481.

[42] N. Y. Zool. Soc. Bull., Nov.-Dec. 1926, XXIX, No. 6, p. 210.

the tree toward the stream, is quite misleading. He cuts, first, the trees on the margin; these always lean toward the stream, so must fall streamward. But later, when cutting farther afield, the trees as often go wrong as right. This I have often seen; and frequently, it has happened that some Beaver made a miscalculation, and was killed by the fall of his own tree.

The largest trunk I have ever seen cut down by Beavers was 14 inches in diameter—this was a quaking asp; but we have records of cottonwoods 20 and 24 inches; 30 inches;[43] and nearly 3 feet.[44] Mills says: "The largest Beaver cutting that I have measured was a cottonwood with a diameter of 42 inches."[45]

These, however, are exceptional; 3 to 8 inches is the usual run. At one Beaver cutting, I counted 116 poplar stumps; there were 6 such places near the dam. The largest stump of all was but 8 inches through.

Many observations lead me to say that a Beaver can cut down a tree about as fast as a man could do it with a rather dull hatchet. Two Beavers can fell a 3-inch sapling in 3 minutes, and a 6-inch tree in an hour or two. On Dec. 6, 1919, Dr. Raymond T. Ditmars showed me a movie of a Beaver cutting down a tree in the Zoo. It was a 4-inch hardwood, and took but 15 minutes to fell. The Beaver plunged into the water as the tree went down.

The work of felling is usually done by the pair, with assistance at times from their grown-up children.

Three are the most that have been seen working on the same tree at once. "With this number," says Morgan,[46] "two nights at most would give ample time to fell a tree a foot in diameter." A party of surveyors in the Beaver country near Marquette "counted 19 tree-falls which they heard in a single night between the hours of 7 and 12 o'clock."[47]

The same observer gives the following interesting description of the felling:[48] "When but two are engaged, they work by turns, and alternately stand on the watch, as is the well-known practice of many animals while feeding or at work. When the tree begins to crackle, they desist from cutting, which they afterward continue with caution until it begins to fall; when they plunge into the pond, usually, and wait concealed for a time, as if fearful that the crashing noise of the tree-fall might attract some enemy to the place.

[43] Am. Beaver, p. 177.

[44] Lewis & Clark, Longman's ed., p. 146.

[45] Watched, p. 56.

[46] Am. Beaver, p. 220.

[47] As above, p. 221.

[48] As above, pp. 172–73.

"The next movement is to cut off the limbs, such as are from 2 to 5 and 6 inches in diameter, and reduce them to a proper length to be moved to the water, and transported thence to the vicinity of their lodges; where they are sunk in a pile as their store of winter provisions. Upon this work, the whole family engage with the most persevering industry, and follow it up night after night, until the work is accomplished. The greatest number of Beavers ever seen thus engaged by any of my informants was 9, while the usual number is much less."

Similar testimony is given in Long's "Expedition to the Rocky Mountains."[49] "Three Beavers were seen cutting down a large cottonwood tree; when they had made considerable progress, one of them retired to a short distance, and took his station in the water, looking steadfastly at the top of the tree. As soon as he perceived the top begin to move towards its fall, he gave notice of the danger to his companions, who were still at work gnawing at its base, by slapping his tail upon the surface of the water; and they immediately ran from the tree out of harm's way."

As an adjunct of work, the Beavers sometimes raise a platform of mud or rubbish around a tree. This enables them to reach up to a thinner place, and thus fell the tree more easily.

Col. L. M. Brett, in charge of Yellowstone Park, writes me, May 12, 1911: "On a recent trip in the Park, one of our scouts found where Beaver had recently felled several good-sized saplings across one of our new trails at a point at least half a mile from water."

The Dam

The dam is the most famous, if not the most remarkable, of the Beaver's undertakings. It is a vast structure, of sticks, stones, roots, mud, and sod, laid across a running stream to back up the water, ensure the Beavers depth enough to protect them from their enemies all summer, and preclude all danger of its freezing to the bottom in winter.

Morgan describes[50] two kinds:—the open stick dam, faced with mud on the upstream side, and through the top of which the water trickles all along; and the solid-bank dam, which is of earth, and has an overflow at one place, where it is reinforced with sticks. I take it that the latter is simply a very old dam in which the sticks have rotted away from the main structure, and which the grass and growing stuff have solidified into a green bank.

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[49] Exped., 1823, I, p. 464; this passage apparently by Thomas Say.

[50] Am. Beaver, pp. 84–85.

The process of building, as nearly as I can tell from having seen many dams in all stages of growth, is as follows:

The Beaver and his wife first decide on the stream they propose to make into a pond—and it is always a small one, sometimes a mere spring. Morgan says[51] that "there is no instance . . . where a dam has been constructed across a stream having a greater depth than two feet at the site of the structure, when the water is at its lowest level."

Next, they select a place where the bed is hard clay or gravel, neither rock nor bog being desirable; and then begin the dam by cutting and laying quantities of brushwood lengthwise in the deepest part of the stream bed, butts against the current. Each stick as it is laid, is partly covered near the thick end with mud, stones, or clay to hold it down; and the process is carried on until the wall is raised, and would, in section, be somewhat as shown in Plate LIX (p. 486). But very rarely is a log used, and never a stake.

By this time, the original bed of the stream is blocked; and the water flooding the shore, calls for a still wider dam. At both wings, it is spread.

Now we shall see why the curvature against the stream is usually given. The force of the current, especially at highwater, is such that a new formation, if down stream, is surely swept away; thus the only correct plan is forced on the Beaver. Exceptions occur, but there is generally an obvious explanation. Some log, root, stump, or hillock was there to suggest a different line, and offer assistance in making it safe.

Night by night, the Beaver family works on the dam, piling up sticks, and burying them in mud that is full of fibrous roots; or anchoring them down with stones of one to six pounds weight. The mud is got in the handiest way, the nearest place; that is, by diving to the bottom of the pond just above the dam. This has a tendency to enlarge the pond, so that in most cases, it is widest and deepest just above the dam, of which the reinforcement, the permanent strength, is in the flood-resisting brushwood.

Thus, it is seen that interlacing branches are the Beaver's safeguard against a washout, just as they are of human engineers who are forced to use wildwood material.

The Dam-wise Beaver

The creature's cleverness in locating a leak, is illustrated in the following: The Hon. J. J. Hall, of Denver, says that some years ago, he made an irrigation dam on a stream near Teluride in San Juan Co., Colo. The dam did not hold; there was a leak somewhere in the bank. Several times he let the

[51] Am. Beaver, p. 105.

water out, and had expert engineers to seek for the leak. All efforts were in vain. Then two Beavers moved in. Immediately after they began operations, they must have found the leak—no doubt, by sensing the faint current—and they effectually plugged it. The dam was thus made tight, and has been good ever since.

A similar instance is furnished by the Phillips, Me., correspondent of the Boston *Globe*. He says: "At Phillips upper village is a woolen mill, driven by water power, coming over a large dam in the Sandy River. Recently this dam has leaked freely; and, though repairs have been attempted, the task was found so complicated and difficult that the dam has never been put in proper shape by man since the leakage was first discovered.

"Suddenly, however, the leakage stopped; and an investigation showed that a colony of Beavers had taken up their abode in the mill pond, apparently coming from farther north on the Sandy River, where these creatures have been known in past years to be quite numerous."[52]

The labour of the Beaver knows no end—no dam is ever finished, or beyond need of repairs.

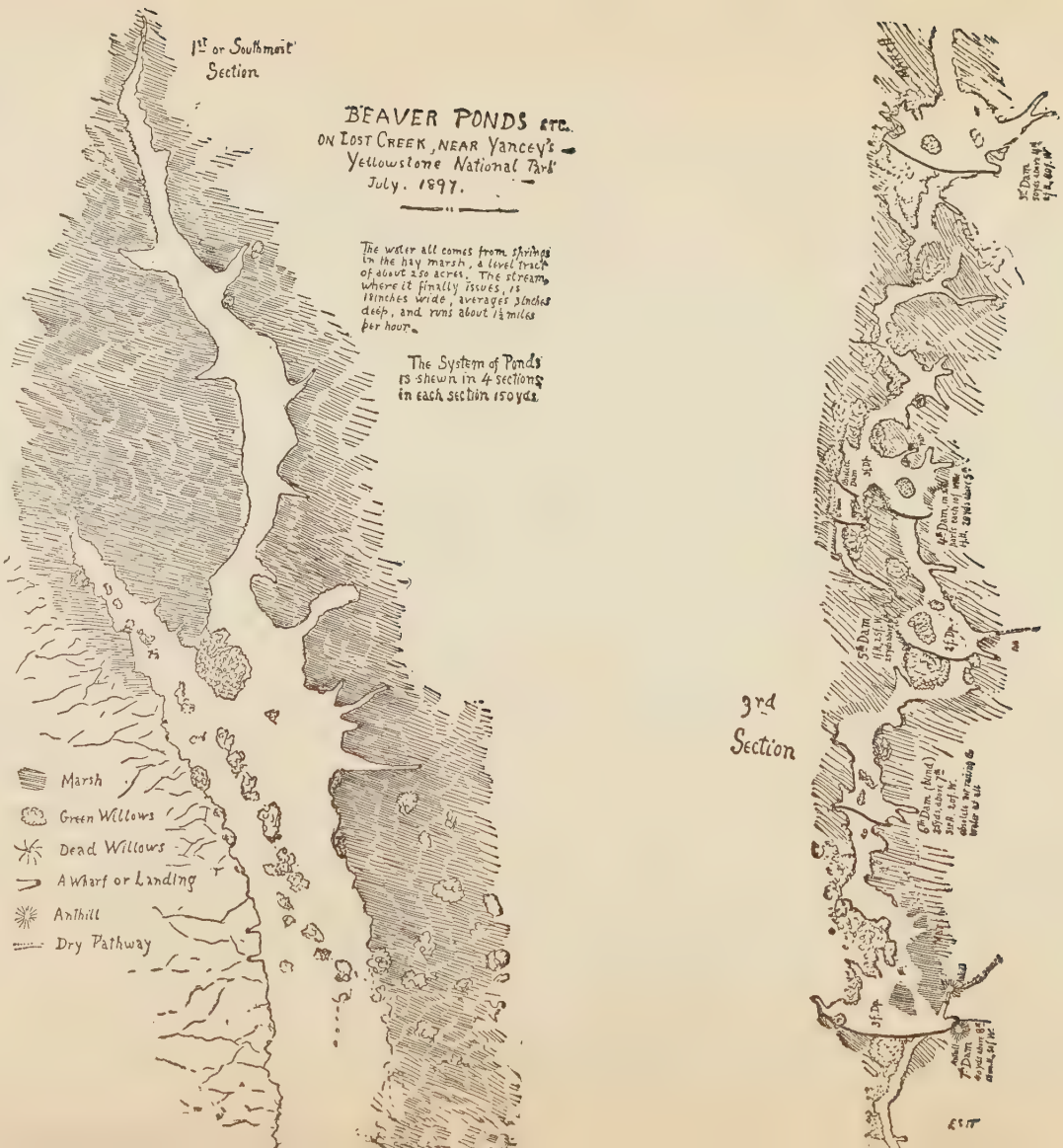
The Beavers near Yancey's, in Yellowstone Park, have, like most wild things there, realized the blessed peace of the Park. They came out soon after sundown while I watched them from a hide in 1897. I saw 4 swimming about at the same time. But only the biggest one seemed interested in repairing the dam; and he worked "like a Beaver" the whole time, never passing the dam without adding something. If nothing else was at hand, he would dive to the bottom for a gob of mud; and pound it into the dam wherever he fancied too much water was running over. It never seemed to occur to him that the water must go over somewhere. So the work of stopping the supposed leak goes on indefinitely and the dam grows bigger.

In menageries where they have given the Beaver the privilege of running water, there is much complaint that in their insensate mania for stopping the overflow, they block drains, etc.; oblivious of the fact that, but for benign and periodic human interference on their behalf, they would speedily bring on themselves the most disastrous kind of a flood.

Morgan remarks[53] that "dams begin to decay as soon as they are deserted by the Beavers, and quickly thereafter disappear"—which is surprising, considering their solidity. This is evidently true, however, for the eastern part of America abounds in beaver-meadows—that is, beaver-pond bottoms—yet it is very rarely indeed that one sees traces of the dams that made them.

[52] Forest & Stream, Jan. 16, 1909, p. 85.

[53] Am. Beaver, pp. 123–24.


1st or Southmost Section
BEAVER PONDS etc.
ON LOST CREEK, NEAR Yancey's
Yellowstone National Park
July. 1897.
The water all comes from springs in the hay marsh, a level tract of about 250 acres. The stream, where it finally issues, is 18 inches wide, averages 3 inches deep, and runs about 1½ miles per hour.
The System of Ponds is shewn in 4 sections; in each section 150 yds.
Marsh
Green Willows
Dead Willows
A Wharf or Landing
Anthill
Dry Pathway
3rd Section

HOUSE
Dead Willows
MARSH
6 or 7ft Deep here
1st or Great Dam. 4½ ft high 15ft wide at base. 30ft long
24 yds above 2nd DAM
2nd Dam 12½ ft wide 3 ft high
30ft Canal
Path To Aspen Woods
12th Dam

PLATE LV.—THE YANCEY BEAVER PONDS, YELLOWSTONE PARK

Drawn from survey made on the ground by Ernest Thompson Seton, July, 1897

Dam Stuff

Two of my observations in contradiction of popular belief, I was glad to have confirmed by Morgan:

1st. Among the scores of dams examined, I never saw anything of the nature of a stake; that is to say, the Beavers do not drive stakes. The nearest approach to it is seen in the following, by Edmund J. Sawyer:

"Only a few days since, I watched a Beaver repairing its dam. Cutting a willow near by, it swam to the dam, thrust the branch into the top of the work, then shoved at it vigorously from different angles until it held fast, resisting efforts to be farther moved."[54]

2d. Beavers rarely use logs in building a dam; I have seen them do it but once. Morgan also mentions a case;[55] it was 1 out of 63. Even that one he considered accidental; possibly that the tree fell on the dam, as it was a trunk that had been blown down, not felled by Beavers.

Stones are freely used when at hand, and Braithwaite says: "I have seen 4 of them [dams] that were entirely built of stones."[56]

A new dam is usually begun in summer; the work on it is pushed vigorously in late summer and early fall. It is probably untouched all winter.

According to Raymond Thompson, "When the spring freshets get in full blast, they often wash away the Beaver's dams; and the animals do not even attempt to repair them at that time. Practically no repair work is done in the spring."[57]

Dam Dimensions

The best opportunity I ever had to study Beaver work was in the Yellowstone Park in 1897. On Lost Creek, not far from Yancey's, where I built a cabin and stayed some months, was a family of Beavers practicing their usual methods of making a great pond of a very little stream. It was from this colony that Elwood (Billy) Hofer took the 3 Beavers which were sent to the National Zoo; and, as nearly as we knew, there were 4 more left in the pond. After spending two days with compass and measuring rod, I produced the accompanying plans (Plates LV and LVI, at pp. 462-3 and 464)[58] of the Beaver's system of interior navigation. The source of all the water was a spring or springs in the marsh above. This took the form of a tiny rill about

[54] Nature Notes Yellowstone, April 29, 1925, p. 4.

[55] Am. Beaver, p. 110.

[56] Habits, p. 1.

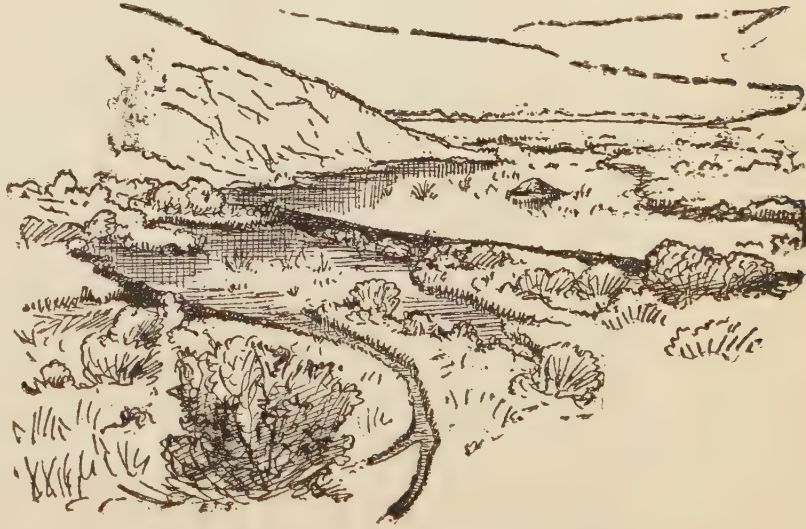
[57] Forest & Stream, Dec., 1925, p. 721.

[58] These I published originally in Recreation Magazine, Oct., 1897, pp. 286–89.

Looking up the valley from the north

The main pond with house, and on the bank beyond, the remains of the aspen woods

First and second ponds from the east side. The present feeding grounds opposite



View from the aspen woods (present feeding grounds, 1897), the 70-foot canal in foreground

PLATE LVI.—VIEWS OF THE YANCEY BEAVER PONDS, YELLOWSTONE PARK, 1897

18 inches wide, and averaging 3 inches deep; and yet it was so managed by this industrious family as to result in 13 ponds.

The largest of these was 6 or 7 feet deep, 250 yards long, 80 yards wide, and covered about 3 acres. This was made by the great or central dam, which was doubtless the oldest; for the aspens opposite were evidently the first to be cut away, the willows in the pond it made were dead, the house was in this pond, and, finally, the fact of its superior size was some guarantee of its seniority. This dam was built largely of stones at the east end where it reached the talus of the cliff; and entirely of mud and sticks where it ran into the marsh. During the first night of my visit, the Beavers added a charred pole, 18 feet long and 5 inches thick—the only pole I saw used there. This dam was 301 feet long, 15 feet wide at base, 4½ feet high in the deepest place, measured to the bed of the stream just below the face; it contained between 100 and 200 tons of material. Such a structure must have taken years of labour, and generations of Beavers to produce. Twenty-four yards below this was the second dam, most happily, if unwittingly, placed to relieve the pressure on the first.

Morgan describes[59] in detail dams which were 488 feet and 551 feet long.

The highest dam he had knowledge of was "about 35 feet long, 12 feet in vertical height; and with a slope of interlaced poles on its lower face, upward of 20 feet in length."[60]

The largest dam, that is, the one which he was "well assured . . . is not surpassed in magnitude by any other Beaver dam in North America"[61] is 260 feet 10 inches long, 6 feet 2 inches high, 18 feet wide at base; holding the water above it at 5 feet higher than in the pool below.[62] This dam must have contained about 250 tons of material.

The dam which makes Beaver Lake in Yellowstone Park, I believe is the longest ever recorded. I saw it from a distance, but had no opportunity of measuring it. General S. B. M. Young writes me that it is about 700 feet from end to end.

Landing Places

Reference to the plan (Plate LV, at pp. 462–3) shows a great many little docks or landing places. These are short canals with raised mud or sod wharfs at the end; they are either lookouts or sunning places. They are found chiefly on the western side, as there is no food on the eastern bank. Usually, from them there are paths leading farther afield.

[59] Am. Beaver, pp. 122, 129.

[60] As above, p. 119.

[61] As above, p. 99.

[62] As above, p. 97.

The dock seems to be the small beginning out of which grew what some consider the Beaver's most extraordinary achievement—the canal.

The Canals

Most naturalists who have studied them agree that the canal is, by far, the most wonderful of the Beaver's engineering feats—not only as interesting as the dam, but, according to Morgan,[63] even stronger evidence of intelligence. He says:

"In the excavation of artificial canals, as a means for transporting their wood by water to their lodges, we discover, as it seems to me, the highest act of intelligence and knowledge performed by Beavers. Remarkable as the dam may well be considered, from its structure and objects, it scarcely surpasses, if it may be said to equal, these waterways, here called canals, which are excavated through the lowlands bordering their ponds, for the purpose of reaching the hardwood, and of affording a channel for its transportation to their lodges. To conceive and execute such a design, presupposes a more complicated and extended process of reasoning than that required for the construction of a dam; and, although a much simpler work to perform, when the thought was fully developed, it was far less to have been expected from a mute animal."

Many canals in all stages of growth are shown on the plan (Plate LV, p. 463); but the largest and most interesting is the 70-footer, leading westward from the second pond. It is the highway to the feeding grounds; is about 18 inches deep up to the fork, beyond which it is but 12 inches deep. It is clean-cut with sharp, hard edges, and has a most artificial look. It ends abruptly at the foot of the bank; and then the path, sharply defined, continues on to the woods, 145 feet farther, and 30 feet higher up.

Morgan describes and illustrates three good examples of canals found near Marquette, Mich. These were 365 feet, 523 feet, and 579 feet long, respectively. All were 2 to 3 feet wide, and had throughout about 18 inches of water. All led from the residential pond to the feeding grounds. (Plate LVII, a, b, and c.)

(a) The first of these,[64] 365 feet long, reaches to the foot of a hill, and then forks as shown. These forks are the remarkable feature of this; "their construction along the base of the high ground gave them a frontage upon the canal of 215 feet of hardwood lands, thus affording to them along this extended line the great advantages of water transportation for their cuttings."

[63] Am. Beaver, p. 191.

[64] As above, pp. 197–98.

(b) The other two are remarkable, not only on account of their length, but because also of their locks. These are best illustrated in the 523-footer.[65] Each lock is a low dam making a foot rise in water level; over these, the logs are dragged. While the main canal is supplied with water from the pond, the locks are fed with rain water gathered by the 142-foot dam next the swamp.

(c) The 579-foot canal[66] has the same general plan as the other, with two locks; but it adds an important feature, namely, a wing-dam set at such an angle into the river that it deflects water enough to keep the canal well filled.

The longest canal I ever examined was a very old one at Gal Pond, near Wanakena, St. Lawrence Co., Adirondacks, N. Y., Aug. 4, 1908. It was 654 feet long, nearly 4 feet wide, and led from the pond to a grove of poplar and yellow birch. Although abandoned for fully 50 years, it was very well marked and showed many Beaver cuttings.

Some valuable observations on a much longer and larger canal are supplied by S. Stillman Berry. This he observed in Montana, and fully set forth.[67] The canal connected the Musselshell River with a remote feeding ground. It was in all 1,145 feet long.

"Measurements taken in the latter part of the month of August, 1918," he says, "showed that near the main bend . . . the canal had a low water diameter of 5 feet, or of 9 feet 6 inches measured across the summits of the levees at the same point. At the mouth, it was 9 feet in diameter (8 feet at water level), with a maximum depth of 1 foot 8 inches, and a low water depth of 10 inches. Where it cut through the willow bank . . . the canal diameter at high water level was 6 feet 9 inches; at low water level 5 feet 6 inches. The low water depth at this point was 1 foot to 1 foot 3 inches. The river near the mouth of the canal was about 50 feet wide at this time."[68]

In addition to the service of floating logs and sticks to camp, there is a second use for the canals pointed out by Morgan.[69] He found them cut across the neck of long points on the river, and even across long islands in the pond, "for the obvious purpose of saving distance in going around."

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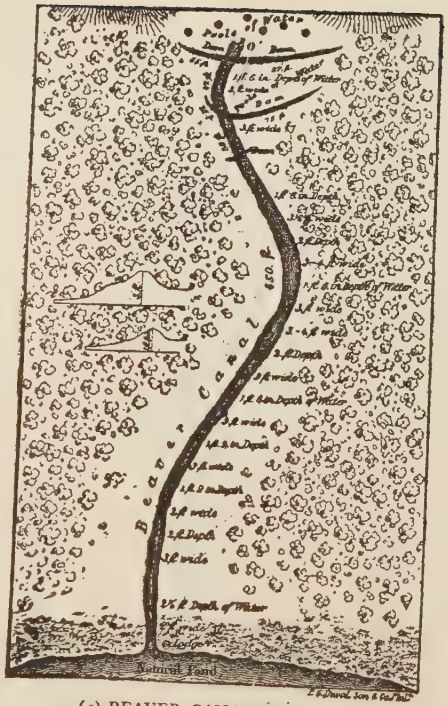
[65] Am. Beaver, p. 196.

[66] As above, p. 200.

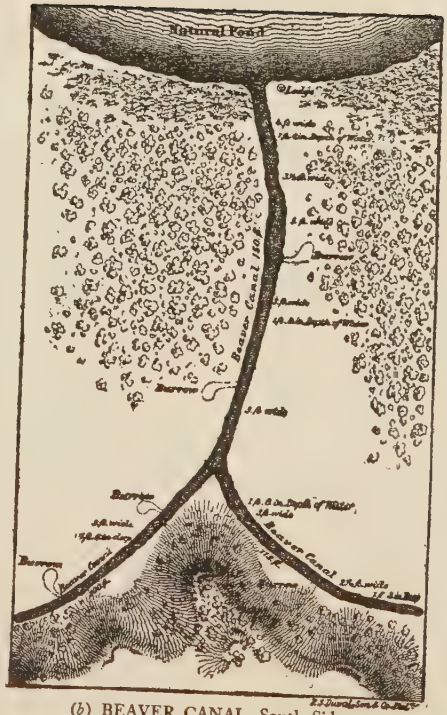
[67] Journ. Mamm., May, 1923, pp. 92–103.

[68] As above, pp. 97–99.

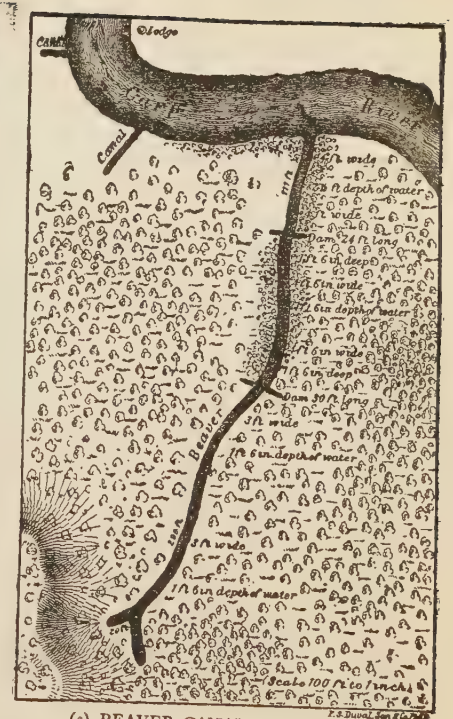
[69] Am. Beaver, p. 202.



(*a*) BEAVER CANAL, North Side



(*b*) BEAVER CANAL, South Side



(*c*) BEAVER CANAL, CARP RIVER

PLATE LVII.—THREE REMARKABLE BEAVER CANALS, REPRODUCED FROM MORGAN'S AMERICAN BEAVER

They are as follows: (*a*), 365 feet long; (*b*), 523 feet long; (*c*), 579 feet long

In brief, then, these canals are among the most wonderful of all the Beaver's wonderful undertakings. They are plainly, the result of a plan adhered to from the beginning. They are made at a cost of enormous labour extending over years, and are kept in repair only by unremitting attention and toil.

They are unquestionably made for the convenience of reaching the feeding ground without a dangerous overland journey; and to assist in the transportation of the heavier sticks used when storing winter food. That is to say, the canals are made for precisely the same reason as those made by man—for the easy transport of passengers and freight.

Beaver Burrows

The Beaver burrow or den is an older institution, probably, than either the lodge or the dam. It is made in a bank near deep water, and is very simple in plan. It has a single entrance, which is below water line under some tree, root, or overhanging bank; it has a diameter of a foot or 18 inches, and a length of a dozen feet. In many cases, it is so enlarged by long use, that a man can crawl into it. It leads to a chamber just above the water line, under a root or stump or clump of bushes, which strengthens and guards the roof, that is here made thin enough to admit air, as we shall see.

A good typical example is shown (Plate LVIII, p. 479); this is the uppermost burrow seen on b, Plate LVII.

In streams which have always plenty of water, and which therefore need not, and indeed cannot, be dammed, the Beaver elaborates the bank-den or "wash." On the Yellowstone, Morgan saw a number of these in 1862, and writes: "The entrances or passageways often extend back 20 feet into the bank; and each communicates with one or more underground chambers, which are always found near the surface."[70] The individuals that live in these, are called "Bank Beavers." I saw numerous examples of their work on the Nyarling River, Mackenzie District, in June, 1907.

In many cases, their entrance is protected with a mass of sticks, which also is winter food. This pile is called a "false lodge." A higher development of the false lodge is seen when it is made by a lake. Then there is no annual freshet to carry away the pile, so it grows yearly.

Over the chamber in the bank, is a thin place made to admit air. In the course of time, this ventilator may give way, leaving the chamber dangerously exposed; in which case, the Beaver is seen, with true constructive ingenuity, repairing the ventilator with a pile of interlacing sticks.

[70] Am. Beaver, p. 159.

Then, as Morgan remarks:[71] "It is but a step from such a surface pile of sticks to a lodge with its chamber above ground, with the previous burrow as its entrance from the pond,"—a case which is precisely paralleled by the bank-house of the Muskrat.

At one time, it was supposed that the Beavers inhabiting a bank-burrow were of a different kind; or, as some said, were outcasts, who for some reason, had been driven from the great family lodge in deep water. There is but little to support this view. There are, indeed, outcast Beavers, and usually they dwell in a bank-burrow. On the other hand, all Beavers do so when nature has given them a sufficiency of deep water without the help of a dam.

It is usual for Beavers to have several burrows as well as a lodge. In the case of the Lost Creek Beavers, one side of this pond was rock; the other side level marsh. So they may have had no burrows; at least, I saw no signs of them.

The Beaver Lodge

The step from the burrow to the bank-lodge is easy. The roofing of sticks made to protect the ventilator, and the continual enlargement of the chamber below inevitably develop the burrow into the bank-lodge, examples of which are shown in Plate LVIII.

From the bank-lodge, the step is easy to the island lodge; and when the island is a mere upturned root or hummock, we reach the final and most specialized dwelling of the Beaver—the moated lodge in the pond.

The development of this may be in two different ways. In the first, the bank-lodge is gradually converted into an island lodge by the rising of the water behind the ever-growing dam, and the digging out of the mud on the land side, to improve at once the house, the dam, and the swimming.

There is, however, another approach to the lodge. Out in the shallow water, the Beavers select a bunch of willows, a log, a rock, or an upturned root, and pile mud and sticks on this, until it settled into a solid mass on the firm foundation with an ever-deepening moat around it; for the Beavers dive, and dig from the bottom, whenever they need mud for lodge or dam.

A typical lodge is a rounded mass of sticks, and occasionally stones. It is 20 feet across the base, and 3 to 5 feet above the water level; the walls are about 2 feet thick. The whole is cemented with mud.

The great pond in the Lost Creek Series at Yancey's, contained but one lodge; this was enormous. It looked 25 feet through, and as high as a man; but, having no boat, I could make no measurements.

[71] Am. Beaver, p. 165.

Braithwaite says that the finished and frozen lodge is strong enough to support the weight of a full-grown Moose, without collapsing.[72] Yet Enos A. Mills testifies that "one night, two of the dead spruces were hurled into the [Beaver] pond. The smaller one had fallen across a housetop; but the house was thick-walled, and, being frozen, had sustained the shock which broke the spruce into sections. The other fallen tree fell so heavily upon two of the houses that they were crushed like shells. At least 4 Beavers were killed, and a number injured."[73]

His Home Layout

As a rule, the lodge contains but one circular chamber, which is about 2 feet high, and 6 feet across. When two or more chambers are found side by side, there is no connection between them. They are, indeed, separate lodges accidentally touching.

A remarkable multiplex lodge is thus described by Hearne: "I have seen a large Beaver house built in a small island, that had near a dozen apartments under one roof: and, two or three of these only excepted, none of them had any communication with each other but by water. As there were Beaver enough to inhabit each apartment, it is more than probable that each family knew its own, and always entered at their own door, without having any farther connection with their neighbours than a friendly intercourse."[74]

There are usually two entrances to each lodge; rarely more—sometimes but one. The first, abrupt, often winding, is the ordinary runway; and the other, quite straight, is for bringing in wood. They are 1½ to 2 feet wide, and 5 to 10 feet long. They are 2 or 3 feet below water level on the outside; but inside, open well above water line. The walls of chamber and passages are finished with mud, which is plastered smooth, as in an adobe house. The floor, about 4 inches above high tide, is covered with a solidified mass of mud and small twigs.

The only air is what comes through the walls, or is incidentally brought in the fur of the inhabitants, or functionally in their lungs. There is more or less dry grass or wood shavings for bedding.

"Each Beaver," says Braithwaite, "has his bed neatly placed against the inner surface of the wall. His bedding is composed, usually, of wood fibres stripped fine, about like an Indian's broom. In the case of lake Beaver, with whom wood is apt to be scarce, blue joint grass is used for bedding. This bedding is taken out pretty often, and a fresh supply brought in; for

[72] Habits, p. 2.

[73] Watched, p. 51.

[74] Journey, p. 230.

the Beaver is a most cleanly animal, and his couch is soon fouled by his muddy occupation."[75]

The lodges "are perfectly air-tight, and being steam-heated by the Beavers, must be very warm and cozy in the coldest weather. Very old Beavers usually build larger houses, work more systematically, and go in for comfort generally."[76]

To this, the same veteran naturalist adds: "They will usually build a new house every year."[77]

Powers, Speed, etc.

We have already discussed the tree-cutting gift of this animal. His other powers show him specialized for the water rather than for the land. When high and dry afoot, he is so slow that man, as well as any of his natural foes, can easily overtake him. He is not generally credited with power to leap; yet the Hon. J. J. Hall, of Denver, writes me that his "friend, Richards, whose camp is 25 miles west of Cody, was riding one moonlight night in the autumn of 1922, by a Beaver stream in the region. He saw a Beaver hard at work. He watched it for some minutes, then deliberately alarmed it. It made the most surprising leap he had ever seen made by a Beaver, and reached the water. The distance cleared by the Beaver was 10 feet on the level."

When cornered, or cut off by the water, he does not, by any means, surrender. Braithwaite tells the fate of his friend's Dog in the woods. He says: "Turnbull had a thoroughbred mongrel Dog which was jealous of the Beaver, and one day attacked him. He only did that once, for the Beaver nipped the Dog's tail off quicker'n a Cat could catch a Mouse."[78]

On the land, the Beaver is but a poor traveller. In the water, he is not one of the swift swimmers; he seems to me to go no faster than a Dog—two miles an hour, is, I should think, his fast speed.

In swimming, the Beaver relies on his hind feet as paddles; the tail is used chiefly as a rudder or for diving; the fore feet are little employed.

Diving for Distance

But his diving power is remarkable.

On Yellowstone Lake, Aug. 5, 1897, I saw a Beaver a good quarter mile from shore; he dived and was seen no more. The water was like a mirror, so we should have seen him had he reappeared short of the land.

[75] Habits, p. 2.

[76] As above.

[77] As above.

[78] As above, p. 3.

The trappers generally credit the Beaver with power to swim a quarter of a mile without coming up to breathe, which implies that he can go fully 5 minutes without breathing.

On this subject, Dr. Charles E. Johnson writes: "A specimen which I once took in a trap, dove; and after it had been under probably half a minute, I took out my watch to time it. At the end of 5 minutes and 10 seconds, I began to fear that the Beaver had escaped; and, poking around with a stick to see if it was still there, after a few seconds located the Beaver under the bank; when I poked it, it came to the surface. It had been under water altogether about 6 minutes; and no doubt, would have remained under longer, had I not disturbed it."[79]

Braithwaite's observations imply that the underwater stay can be greatly prolonged, almost made indefinite, by means of an expedient, a sort of artificial respiration that the species has evolved. He says: "The ability of a Beaver to remain under water for a long time, is really not so tough a problem as it looks. When the lake or pond is frozen over, a Beaver will come to the under surface of the ice, and expel his breath so that it will form a wide, flat bubble. The air, coming in contact with the ice and water, is purified, and the Beaver breathes it in again. This operation he can repeat several times."[80]

Mating and Breeding

Most authorities maintain the Beaver to be a strict monogamist; notwithstanding that Vernon Bailey holds the species to be polygamous.[81] The mating season is January or early February; and the pair make, then and there, a contract for life.

Gestation lasts about three months. A valuable contribution on the gestation of the Beaver in Oregon, is offered by Theo. H. Scheffer, of the Biological Survey, Puyallup, Wash.[82] In each of 3 pregnant females, he found 4 fetuses; in 3 others, there were 3. Apparently, impregnation took place in late January.

On Feb. 8, fetal sacks were about $1\frac{1}{4}$ in. in diameter
Mar. 8, 8 in. in total length
Mar. 26, $5\frac{1}{4}$ " " " "
Apr. 7, $8\frac{3}{4}$ " " " "
Apr. 10, $10\frac{1}{2}$ " " " " and furred all over
Apr. 17, $8\frac{1}{4}$ " " " " " " " "

[79] Adir. Beaver, p. 175.
[80] Habits, p. 3.
[81] Beaver Farming, p. 9.
[82] Journ. Mamm., May, 1925, p. 129.

Toward the end of April, the mother separates herself from her mate; that is, I suppose, compels him to move out and keep away, while she prepares for the brood in the old lodge. She makes a warm nest of dry grass—so at least say the trappers—but it is not very clear how the mother keeps the grass dry when she must swim under water with it. Harry V. Radford believes that the bedding is not grass, but always of wood finely shredded in the lodge, therefore dry.

The Kits

Here the kits, as the trappers call them, are born in the month of May; their eyes are open from birth.

Usually, they number 2 to 5. According to Morgan,[83] however, one William Bass "found 8 young Beavers in a foetal state in one female, and 8 young Beavers born also in a single lodge. He had also found 6 young ones a number of times; and all the numbers below this, down to a single young Beaver." Since the mother has but 4 teats, a family of 8 must be an embarrassing problem.

Vernon Bailey says: "Nine Beaver, 5 young and 4 old, is the largest number I have ever found inhabiting one house; but others have reported larger families in very large houses."[84]

Hearne says that the Beaver families "seldom exceed 4 old and 6 or 8 young ones; though, by chance, I have seen above double that number."[85]

Speaking of an exceptionally large lodge with many chambers, the same traveller says: "The Indians of my party killed 12 old Beaver and 25 young and half-grown ones out of the house . . . and on examination, found that several had escaped."[86]

At the age of a month, the young begin to eat solid food, and go abroad with the mother.

Vernon Bailey's experiences with two baby Beaver in Minnesota,[87] offer valuable light on the raising of such delicate creatures. He and his Indian guide went to a Beaver lodge, knocked civilly on the outer wall, and then watched, as he says, "for a responsive line of bubbles sent up from the fur of the old Beaver as she swam away below the surface.

"'There's one—two of them,' suddenly exclaimed Chippewa John, pointing to a couple of small brown heads on the water a short distance from the house. . . .

[83] Am. Beaver, p. 221.

[84] Journ. Mamm., Feb., 1926, p. 42.

[85] Journey, p. 228.

[86] As above, p. 230.

[87] Johnny & Paddy, pp. 3–7.

"Evidently the babies had been enjoying their luncheon inside when the mother became alarmed at our disturbance, and plunged out of the house, the babies clinging each to a tough nipple until well out in the lake—a safety device common to many young rodents. . . .

"'Get them quick, or they'll drown,' we cried, for it was evidently their first swim. Shooting the boat ahead, our guide reached down and picked up by the tail, first one and then another furry, dripping, little body. Our first Beavers! Now we could really learn something."

But more than once, the attempt to raise them came near a tragic end, for the usual reason—unnatural food, no Beaver milk.

"Alas, the formula of Beaver's milk was an unknown quantity," says Bailey, "and on a cow's milk diet, the poor little fellows became the prey of all the ills to which other motherless babes fall heir. We experimented with skimmed, boiled, and diluted solutions, adding popple leaves to give it a more natural flavour. Later, we tried rolled oats and bread. Nevertheless, the digestive tracts of the little Beavers never fully recovered tone until they graduated to their natural wild food. Lily pads and stems seemed to be particularly good medicine, with water grass and the white stalks of tulés and cat-tails by way of variety. After about 6 weeks, when they gave up milk entirely, they ate the bark, twigs, and leaves of a variety of bushes. Aspen was their favourite tit-bit, but beaked hazel, pin cherry, bush maple, alder, willow, and birch were also devoured with gusto."

In summary, then, his experiences in raising them were too emotional at times. The kits were eager enough to feed, but the natural food was not available, and the best solution unknown. If some of our milk experts would tell us the exact composition of Beaver milk, Wild Sheep milk, Antelope milk, etc., they could help us to solve the hardest of all the problems in raising wild animal babies.

Enos Mills, describing a wild family that he was observing, says: "A few mornings later, the baby Beavers appeared. The mother attracted my attention with some make-believe repairs on the farther end of the dam; and the 5 youngsters emerged from the house through the water, and squatted on the side of the house before I saw them. For a minute, all sat motionless. By and by, one climbed out on a projecting stick and tumbled into the water. The others showed no surprise at this accident.

"The one in the water did not mind, but swam outward where he was caught in the current that started to carry him over the dam. At this stage, his mother appeared. She simply rose beneath him. He accepted the opportunity, and squatted upon her back with that expressionless face which Beavers carry most of the time. . . . The youngster sat on his mother's back,

as though asleep; while she swam with him to the house. Here he climbed off in a matter-of-fact way, as though a ride on a ferry-boat was nothing new to him."[88]

At six weeks, they are weaned; but they continue with their mother for a year longer at least.

"The mother Beavers," says Braithwaite, "remain at home all summer, while the rest of the tribe are ranging about until September, when they commence to club together again. The kittens generally remain with the mother for two years. When they are three years old, they mate and start off on their own hook."[89]

The Father

What little evidence there is, goes to show that the male is a model parent. Naturally, his duties are small, since he is not called on to nurse, feed, lead, or defend the young. Some fathers are considered models when they refrain from doing bodily harm to their offspring; and are especially admired if they keep away altogether while the young are helpless in the nest.

He and his pals go a-roaming all summer, sometimes living in lone bank-houses, sometimes gathering at the club, which is a lodge of males only.

In September, he rejoins the family circle, makes the acquaintance of his offspring, and sets vigorously about preparing house, dam, and larder for the winter coming on.

My observations would indicate that, in these laudable activities, he is by far the hardest and most assiduous worker. His industry is tireless. Both wife and children take it for granted that father will do it; so they have a comparatively easy time.

Outcast or Bachelor

Just as, among Buffalo and Moose, we have the lone bull that is more or less of an outcast, so in the Beaver world, we have individuals—old males—that are outcasts or degenerates, either from choice or necessity. Many strange theories are brought forth by trappers and Indians to explain these. This much only is certain—they are outcasts, and they are failures.

"It is a curious fact," says Prevost, the trapper,[90] "that among the Beavers, there are some that are lazy, and will not work at all, either to

[88] Watched, pp. 52–53.

[89] Habits, p. 2.

[90] Quoted in Q. N. A., I, p. 352.

assist in building lodges or dams, or to cut down wood for their winter stock. The industrious ones beat these idle fellows, and drive them away, sometimes cutting off part of their tail, and otherwise injuring them. These 'Paresseux' [idlers] are more easily caught in traps than the others, and the trapper rarely misses one of them. They only dig a hole from the water running obliquely toward the surface of the ground 25 or 30 feet, from which they emerge, when hungry, to obtain food; returning to the same hole with the wood they procure, to eat the bark.

"They never form dams, and are sometimes to the number of 5 or 7 together; all are males. It is not at all improbable that these unfortunate fellows have, as is the case with the males of many species of animals, been engaged in fighting with others of their sex; and, after having been conquered and driven away from the lodge, have become idlers from a kind of necessity. The working Beavers, on the contrary, associate—males, females, and young together."

Morgan offers an explanation which at least puts the "sluggards" on a higher plane. These "outcasts," he says, "are probably such Beavers as, having lost their mates, refused afterward to pair, and led thenceforth solitary lives in burrows."[91]

It has even been suggested that they are eunuchs, so made through accident or disease.

Describing the old outcast in the Beaver colony at Washington Zoo, Dugmore says: "It is difficult to imagine a more pathetic sight than that of the poor old Beaver, solitary and so entirely alone; within sight of his comrades, yet not among them; unable to join in their games and their work, living his lonely life like a hermit."[92]

"When spring came, it was found that the Beavers had increased in numbers, very much to the delight of all concerned: but the following year, when they were all full-grown, the rules and regulations of Beaverdom were put in force. They decided that there was one too many; and, according to their laws, he must either betake himself to some other locality, or submit to an untimely death. Now, the victim chosen—whether by ballot or by what other means, who can say—was our old friend; and, as it was impossible for him to leave the colony of his own accord, death would have been his lot, had not the keeper come to the rescue."[93]

Near Kippewa, Que., however, I knew of a solitary he-Beaver that did build a large dam in 1904. But, as noted elsewhere, he was not solitary from

[91] Am. Beaver, pp. 136–37.

[92] Romance, p. 162.

[93] As above, pp. 167–68.

choice, and spared no effort till he had changed his condition, finally achieving a family of his own.

The Sociable Workers—Signals

Being essentially sociable, the Beaver has many methods of communicating ideas. The first of these is the vocal. Young Beavers wail like crying children. Older ones hiss in menace, or utter a querulous "churr." When two meet in the pond, I have several times seen them nibble each other's cheeks, at the same time uttering a chattering noise; I suppose it is a friendly salutation.

"In the season of love," says Richardson, "their call resembles a groan, that of the male being the hoarsest; but the voice of the young is exactly like the cry of a child."[94] Whether this is a true love-song, is not yet determined. Perhaps, like many of their kinsfolk, they have some quite different rarely uttered, and joyful call—a prolonged expression, that has hitherto escaped observation.

The Beaver's most important signal—the one most often heard—is the "splash." While watching the Beavers at Yancey's, I learned that, at once, on discovering danger, each Beaver gives a great slap with his tail and dives; this is understood by all, and repeated by each as he plunges. Among the hunters on the Nyarling River, I found that it is considered the sign of a mortal wound if the Beaver dives without slapping.

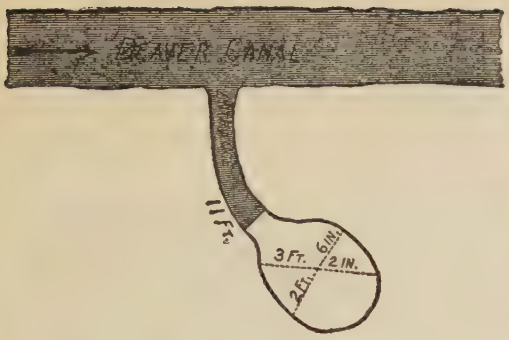
The sound of it on a quiet evening is very far-reaching; it is, in fact, two sounds—one a loud "slap" as of a paddle, followed at once by a deep, hollow plunge, as though a ten-ton boulder had been dropped in the water.

That there are many other signals in use among them, is beyond question.

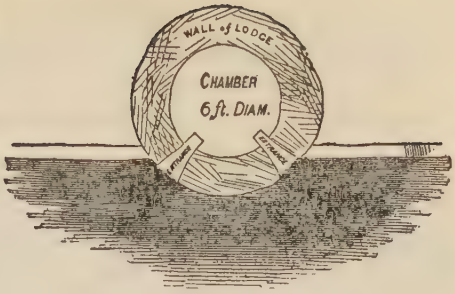
Apparently, Mills is convinced that, in the wet republic, there is an elaborate system of intercommunication; and yet he cannot divine its form or elements. He says:

"Beavers coöperate and carry out a distinct plan; in doing this, they work both unitedly and singly. The whole work, however, advances as though to a plan, and as though under constant supervision. Through the years, I have seen Beavers working hundreds of times. Their work is nearly always sufficient, and apparently under the direction of an expert in Beaver work; but never have I seen any sign or signal given by a Beaver that I could positively say was an order or command. But I see no way of explain-

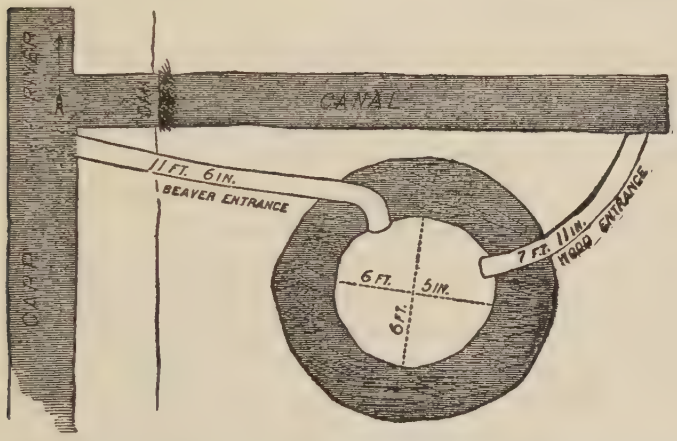
[94] Narrative, p. 91.



Plan of a Beaver burrow
(From Morgan)



Ground-plan of a bank-lodge
(From Morgan)



Ground-plan of a more elaborate bank-lodge, showing the nearly straight wood entrance in dead water, and the Beaver entrance in the running stream

(From Morgan)

A 5-inch aspen just felled

PLATE LVIII.—BEAVER WORKS

ing the magnitude of Beaver works, and the skill shown therein, except through coöperation under an acknowledged leader."[95]

Curiosity and Tolling

Henry Bannon attributes a large measure of curiosity to the species. He says: "A strange noise, such as is made by striking the canoe with the paddle, or by casting a stone into the water, will often call Beaver from their lodge in the daytime. Once the trapper tapped his gun-stock three or four times with a knife. In less than a minute, a Beaver emerged from his lodge, and swam about until he saw us; then he returned into the lodge."[96]

"Upon another occasion, we were near a lodge located in a pond whose waters were not clear. Again the same noise was made. After waiting several minutes, and neither Beaver nor ripple appearing on the surface, we turned to go. As we did so, there was a splash a few feet in our rear. The Beaver had come through a little underground canal to a small pool near where we stood, and had evidently been watching us all the time."[97]

What is it that attracts the Beaver? Curiosity concerning a stranger, or accidental use by a stranger of a definitely established signal? That there is an important, unwritten chapter here awaiting the wise watcher, is evidenced, among other things, by Millais's note on Beaver tolling. He says:

"Beavers, when they have been undisturbed for long, are very curious in relation to strange sounds. They will come swimming out of their house even at the firing of a gun. The Indians usually call them with a hissing noise, or one produced by munching the lips. Another favourite 'toll' is a sound made by tapping the trousers with the hand. The most successful Beaver 'caller' in Newfoundland is John Bernard—or Johnny 'Bow-an'-arrow,' as he is named by the Glenwood folk—who, when the season for the animals was 'open,' killed great numbers by making a sound that resembled the cutting of chips off a tree. It is said that the unfortunate rodents never fail to respond to this noise."[98]

Mud Pies

Besides these signals, there is another way in which Beavers convey ideas. It may be called the mud-pie telephone. The Beaver, like birds, has

[95] Watched, p. 135.

[96] Days, pp. 513–14.

[97] As above, p. 514.

[98] Newfoundland and Its Untrodden Ways, 1907, p. 211.

a cloaca or one orifice—urinal, genital, and anal combined; each (male or female) has, close to this, two pairs of glands. The large ones are the "bark-stones" or castoreum glands, secreting castor, corresponding, according to Dr. W. W. Ely,[99] to the preputial glands; and the smaller, the "oil-stone," secreting a lubricant.

The castor is a yellowish substance, commonly described as "strong-smelling." Its odour certainly is peculiar, but it seems to me rather faint. These two secretions are given off at will by the animal, usually while voiding urine or excrement; and are a most important, though ill-comprehended, method of intercommunication.

Whatever the explanation, there can be no doubt that the smell of castoreum has a wonderful fascination for the Beaver; and is used almost universally by the trappers, as a lure or charm to decoy the fur-bearer to his fate.

Nor is this infatuation confined to Beavers, for most mammals respond to its dangerous attractions; and mixed with various other substances to intensify it, or make it more easy to handle, it forms a part of every trapper's stock-in-trade.

This, probably, is the broad, underlying idea: the product of the gland varies with the age, sex, and condition of the individual. The next Beaver that passes, can get light on these things by study of the castor left in the little pile of mud; thus, it serves as a means of spreading intelligence; in particular, about sexual matters, hence its power.

When I was camped at Big Dam Lake, 40 miles east of Kippewa, Que., Sept. 21, 1905, I saw much Beaver work; and learned from Mittigwab, the Indian guide, that all of this was the work of one old male Beaver that had lived here alone for two or three years. He wandered as much as 15 miles upstream from the lake, and $1\frac{1}{2}$ miles from water, especially in early spring, when the ice first broke up. He advertised energetically; for his mud pies, with a dash of informational castor, were on every corner and point for at least 100 miles of shore, proclaiming to all who understood what a very solitary and miserable life was his, and how earnestly he did strive and pray to find a mate.

But, for years, he continued alone. Beaver were scarce in that country; and trappers relentless when a strange Beaver wandered in. In 1906, however, his persistence was rewarded with success. A perfectly compliant and agreeable female responded to his ad. The credentials exchanged were evidently satisfactory; for in 1908, I learned that he was the happy patriarch of a large and successful community.

[99] Am. Beaver, p. 301.

Play

We should expect such a sociable creature to show considerable advancement in development of play; and even here, it seems the castor takes a prominent place. Morgan says:[100] "Occasionally, they indulge themselves at play, for which a formal preparation is made. After selecting a suitable place upon dry ground near the pond or stream, they void their castoreum here and there upon the grass; and, in the musky atmosphere thus created, spend some hours at play or basking in the sun. The trappers call these playgrounds 'Musk Bogs.'

"Two or three of them are often seen at play in the water—diving, swimming around, and ducking each other."

A trapper, named Prevost, called the attention of Audubon and Bachman[101] to a peculiar habit or game of the Beaver. "He said that when two Beaver lodges are in the vicinity of each other, the animals proceed from one of them at night to a certain spot, deposit their castoreum, and then return to their lodge. The Beavers in the other lodge, scenting this, repair to the same spot, cover it over with earth, and then make a similar deposit on the top. This operation is repeated by each party alternately, until quite a mound is raised, sometimes to the height of four or five feet."

Thus, they have invented a game on the line of piling dominoes, or playing "hands" as enjoyed by children; or possibly like a contest of social events between two social queens, each seeking to go the other one better, to set a higher mark.

"They are very playful," says Dr. John Richardson, "as the following anecdote will shew: One day, a gentleman, long resident in this country, espied 5 young Beavers sporting in the water, leaping upon the trunk of a tree, pushing one another off, and playing a thousand interesting tricks. He approached softly, under cover of the bushes, and prepared to fire on the unsuspecting creatures; but a nearer approach discovered to him such a similitude betwixt their gestures and the infantile caresses of his own children, that he threw aside his gun. This gentleman's feelings are to be envied; but few traders in fur would have acted so feelingly."[102]

E. L. Chicanot, telling of Beavers that he recently watched by night in central Alberta, says: "It was very interesting to observe them, though I was never able to determine exactly what they were doing—playing or making love; certainly they were not engaged upon any of the serious businesses

[100] Am. Beaver, p. 223.

[101] Q. N. A., I, p. 353.

[102] Narrative, pp. 91–92.

of life. They circled about each other in a clumsily dexterous manner, and administered good-natured cuffs with their webbed paws. They snarled at each other much in the manner of playful puppies, though their naturally unprepossessing aspect detracted from a very happy mien. They never reëntered the water, but moved around on the same narrow spot; and when their antics grew monotonous, and there seemed no climax of any kind arriving, I backed carefully away, and am sure the animals never knew how near they had been to one of the humankind, or how imminent destruction might have been."[103]

Food of the Bark-eater

Closely connected with the building instinct is the food instinct of this animal. His favourite diet in Canada is the bark of the poplar or quaking aspen; but he also eats the young bark and twigs of most of the hardwoods. In summer, he adds many kinds of vegetation, even berries, pond-lily roots, and marsh grass; and in winter, the wood itself.

But he never is known to eat any part of coniferous trees, except in the absence of other food; although he cuts them down for building material.[104]

Richardson thus sums it up: "Their favourite food is the bark of the aspen, birch, and willow; they also eat the alder, but seldom touch any of the pine tribe, unless from necessity; they are fond of the large roots of the *Nuphar luteum*, and grow fat upon it; but it gives their flesh a strong rancid taste.[105]

Enos A. Mills, with abundant opportunity, enlarges on this. Describing a certain Beaver family, he says: "The upper part of the area flooded by their pond had been a semi-swampy tract, bearing thick growths of water-loving plants. The roots of sedge, bulbs of lilies, tubers of many plants, and long, juicy roots of willow and alder, were made use of by these Beavers, facing a food shortage.

"I supposed it was only a question of time before they would be shut off by the thick ice from this root supply. But they dug a deep waterway—a canal about 2 feet wide, and nearly as deep—from the house in the centre of the pond to the heart of the rooty area. Even after most of the pond was frozen to the bottom, they had an open line of communication with the root supplies."[106]

"I had glimpses of the Beavers' eager digging through the clear spots in

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[103] Canadian Forest & Outdoors, Sept., 1923, p. 591.

[104] Am. Beaver, pp. 183–84.

[105] Narrative, p. 91.

[106] Watched, pp. 210–11.

the ice. They tore the root-filled section to pieces, and devoured all that it contained. But not until the following summer, when the broken dam released the water, did I realize how deeply and completely the bottom of the pond had been stirred and ploughed. I have seen gardens uprooted by Hogs, and mountain meadows dug to pieces by Grizzly-bears; but neither of them equalled this."[107]

Finally, he adds: "Beavers do not eat meat or fish, but chiefly bark, with a little of roots, mushrooms, lily bulbs, and berries."[108]

A suggestive inquiry is at hand from Frank A. Kaban, of Seattle, Wash. He writes me: "On one of their feed haul-ups, I found two *Cicuta* (or poison hemlock) roots, the tops and all the small rootlets of which had been eaten off. Each of the roots proper had two or three small bites taken out of them, as if they had been sampled.

"Could you tell me whether or not Beaver would be poisoned by *Cicuta?* It is very common here; and if it is as poisonous as is commonly supposed, I don't see how any Beavers survive. I have never found a dead one."

In summary, Hearne says of his pet Beavers: "In general, during the winter, they lived on the same food as the women did, and were remarkably fond of rice and plum pudding: they would eat partridges and fresh venison very freely; but I never tried them with fish, though I have heard they will at times prey on them. In fact, there are few of the granivorous animals that may not be brought to be carnivorous."[109] Which last remark is true, in the same sense as the statement that small boys eat slate pencils and chalk.

Storage

Like most of the rodents which do not hibernate, the Beavers store up food for winter. All through the autumn, they labour. The suitable trees next the bank are first attacked; if they fall into the water, they are allowed to lie there, as it is easy to cut their branches later under the ice. If they fall on the land, all the branches are cut off into pieces of a size possible to handle, that is to say, "when 5 inches in diameter, they are usually about a foot long, when 4 inches in diameter, they are about a foot and a half long, and when 3 inches in diameter, are about 2 feet long. Poles from 1 to 2 inches in diameter, are often found 8, 10, or 12 feet in length; and also cut up into short lengths, from a few feet to a few inches long."[110]

[107] Watched, p. 212.

[108] As above, p. 134.

[109] Journey, p. 244.

[110] Am. Beaver, pp. 178–79.

These sticks are brought to the lodge to be stored in two different ways. The heavier timbers are sunk in the bottom of the pond. How they are sunk, is often discussed. I have heard men who should have known better, say that the Beaver sucks all the air out of them to make them sink; or that the Beavers charm them, but that your touch breaks the charm, and the logs float up. The fact is that most green woods are nearly as heavy as water; if waterlogged, they are heavier. The Beaver carries the green stick down to the bottom, and partly buries it in the mud; very little holds it. In a week or so, it is waterlogged, and lies there even if uncovered. If anyone pulls at a piece of poplar, for example, just after it is sunken, it floats and will not stay down without weighting. These things I saw and proved to my own satisfaction on the Nyarling River, near Great Slave Lake, in June, 1907.

The smaller branches are stored in a different way. In the water above Beaver lodges, that are situated in a current, is a pile of brushwood moored to the bottom, and apparently not used for food. This, Morgan considers, is a safe storage place for the smaller twigs that might be carried away by the stream."[111]

Bannon's opinion, after years of observations, is thus set forth: "During the fall, Beaver are busy animals. They are at work laying up their winter's cache of food. They come to the bank of the pond or the stream, climb up the trails, cut willow or cottonwood sticks, carry them to the water, and then swim with them to the cache near the lodge. The cache is in the water. To make it, the Beaver first plant a few sticks in the mud for the purpose of forming an obstruction. This done, they bring hundreds of branches and twigs, and so release them that they will catch against those in the mud, and become interwoven. The ice finally covers the water, but the Beaver's food is beneath the ice.

"During the winter, a Beaver goes from the lodge to the storehouse, cuts a branch from the cache, returns to the lodge, eats the bark, and then puts the peeled stick into the current which carries it away."[112]

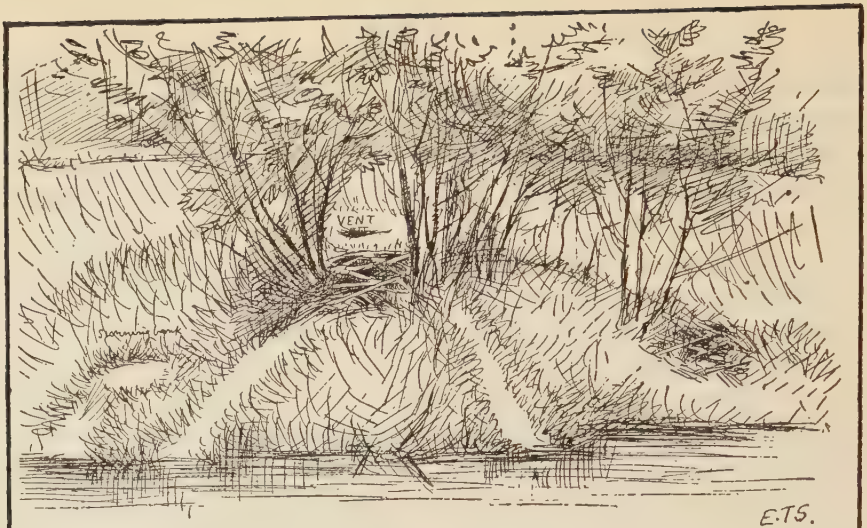
During the summer, the Beaver commonly takes the piece into the lodge, eats the bark off, and later adds the useless stick to the roof-tree or to the dam.

The Wits of Amik

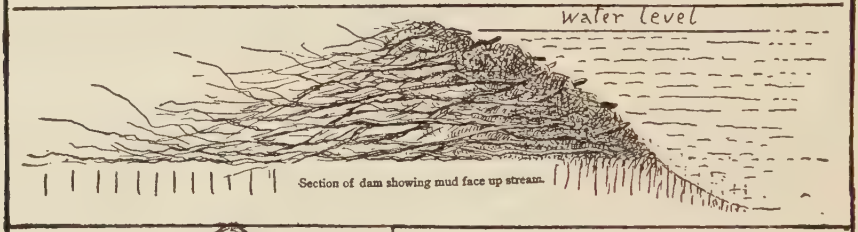
The intelligence of the Beaver has been much discussed. There was a time when it was considered on a par with that of man; and tales, marvellous and preposterous, were told in verification. A reaction set in, and it became

[111] Am. Beaver, p. 188.

[112] Days, p. 513.



Double Lodge in bank 12 yds long, 4½ ft high. Nyarling R., 7 July 1907 12 yds long 4½ ft high



Section of dam showing mud face up stream.

Beaver carrying mud on its tail from photo by Josef Brunner 1904

Plate LIX — Beaver poses & details

generally accepted that the Beaver, being in the Rabbit and Porcupine class, was of no heavier mental calibre than they. Now, thanks to such observers as Hearne and Morgan, we are reaching the true line; and find it, as usual, in the middle of the road.

While of a low general mentality, the Beaver has a wonderfully developed instinct for the building of dams and waterways; a quickness to take advantage of little things, and a ready adaptability to change of surroundings. These aptitudes put the Beaver in the highest class of low animal intelligence—a case parallel with that of the ants indeed; which though so far down in the scale of life, have acquired extraordinarily complex instincts —instincts whose history affords one of the most wonderful "fairy tales of science."

The building of lodges, lakes, dams, and canals is the most obvious proof of the Beaver's mental gifts; but another evidence is supplied by the trappers. One of their usual modes of catching the hard-working pond-maker is by forcing a break in the dam; and in this break, setting one or more steel traps. The Beaver quickly senses the leak, and the peril of it. He sallies forth at once to make the necessary repairs—and is caught. In places of much persecution, however, he waits till black night before exposing himself.

Raymond Thompson, commenting on this, says: "A small break is made in the dam, and two or three traps set slightly to one or both sides of the break. The Beavers will attempt to repair the dam; and one, at least, should get caught. But occasionally, you will run across a trapwise old Beaver who will give you a run for your money. When you make the break in his dam, he will drag brush and mud over your traps, often burying them with a foot or more of muck. I have trapped dozens of such Beavers. Sometimes they will climb up over the dam, and attempt to mend the break from the lower side.

"But the smartest Beaver may be fooled if one goes about it intelligently, and has time to spare; providing, of course, Old Castor doesn't paddle off to parts unknown when things get too warm for him. The main secret is this: leave no sign or human scent. If you walk along a shore, leaving tracks in the mud, and making all kinds of signs where you make the set, the Beaver will know just as well what has been going on as if you had marked the exact location of the traps with a red flag."[113]

A skillful trapper has a contrivance by which the Beaver, when caught, is held down in deep water, so is speedily drowned. The inexperienced merely catch the Beaver by the leg, and so give him a chance to foot himself and escape. On this subject, Thompson remarks:

[113] Forest & Stream, Dec., 1925, p. 719.

"If caught in a trap fastened by ordinary methods, the animal will soon wring his foot off, and escape. The writer has caught Beavers that had been caught by all four feet at different times; both fore feet were missing, and the hind ones all scarred where they had wrenched free from the grip of the steel trap. We have never known a Beaver to wring off a hind foot, although we have caught many of them that were minus one or several hind toe-nails."[114]

Manly Hardy gives similar testimony. He says: "While a Beaver rarely, if ever, takes off a hind foot, he will in many cases, take off a fore foot, sometimes within a few minutes. I have seen Beaver skins which showed that the owner had lost both fore feet."[115]

Henry Bannon adds: "I was told of an inexperienced trapper whose catch for one season consisted of 3 Beaver and 17 feet."[116]

Responding to Sanctuary

In Algonquin Park, Canada, as already set forth, the Beaver have prospered mightily under the beneficent protection of the Canadian Government; and have responded, both in numbers and in behaviour, to the kindly treatment. They have become surprisingly tame. While I was there in Aug., 1922, we saw Beaver calmly feeding right in camp during late afternoon, while the sun was shining on them. On the 12th of August, about 7:30 P. M., while I was lighting the first fire, and dedicating the new Council Ring, a Beaver came out of the near stream; and at exactly 30 paces from where, with 200 campers I stood, he cut down a $4\frac{1}{4}$-inch aspen tree; then, without delay, he cut off 8 feet of the butt, and dragged the top into the stream. The boys brought in the butt piece, as the Beaver's contribution to the new Council Ring. The cutting, etc., took less than 20 minutes.

At the railway station, Aug. 21st, we found that a ranger had a young 10-pound Beaver, captured the day before. It was very tame and gentle; but had a most unpleasant way of rubbing its nose against my jugular vein, and chattering its teeth as I held it to be photographed. In the background was a new Beaver dam and pond.

Once More Diurnal

During the four centuries that our trappers have harried the simple Beaver for his clothes, they, with one voice, have described him as a furtive, shy, and strictly nocturnal animal. "No man ever saw a Beaver at work

[114] Forest & Stream, pp. 719–20.

[115] A Fall Hunt in Maine, Forest & Stream, May 14, 1910, p. 769.

[116] Days, p. 510.

when the sun was up" is a condensation of a million tales. For this reason: all Wild Beaver photographs hitherto taken have been flash-lights.

But the inspiring success of the Yellowstone and other sanctuaries, has made us know something of the old condition. In the days which I spent at Yancey's (1897), the Beavers came to business at or before sundown. Since then, they have further improved; and are often seen hard at it when the sun is high. In all regions where well-protected, it is the same—they revert to the habit of safe days.

Henry Braithwaite says: "I have often seen them working in the daytime, especially in the spring of the year, when it freezes too hard at night for them to cut their wood. I have known them to come out of their houses at 11 o'clock in the forenoon; and it is a common thing for them to appear at 3 o'clock, and work till dark."[117]

In discussing the protected Beaver of Rocky Mountain Park, Enos Mills says: "In out-of-the-way places, where they had not been disturbed, I have seen a whole colony at work during the daytime, even when the work was not pressing."[118]

Disease and Age

Like others of our beasts, this species has its years of increase and decrease; and also is subject to diseases that are, as yet, not understood.

"In some seasons," says Richardson, "a great mortality occurs amongst the Beavers, from some unknown cause, many being found dead in their lodges."[119]

A visitation of this kind was evidently experienced in the Manitoba region about 1800. Thus, on Jan. 1, 1805, Alexander Henry abandoned his trading post at Pembina River, giving as his reason that the country was then "almost destitute of Beaver."[120] Think of it! In the best of all Beaver country, where, the year before, he had collected 1866 Beaver skins;[121] and other traders had done as well in the district. The cause of the change is not intimated, but must have been disease.

Further light on the same is supplied by Tanner, who at that time lived with the Ojibway Indians of Minnesota. He says[122] of the Beaver on Upper Red River about 1800: "Some kind of distemper was prevailing among these animals, which destroyed them in vast numbers. I found them dead and dy-

[117] Habits, p. 1.

[118] Watched, p. 131.

[119] F. B. A., I, p. 108.

[120] Quoted by E. Coues, in Henry's Journal, p. 256.

[121] As above, p. 245.

[122] As above, p. 256.

ing in the water, on the ice, and on the land; sometimes I found one that, having cut a tree half down, had died at its roots; sometimes one who had run a stick of timber half way to his lodge, was lying dead by his burden. Many of them which I opened were red and bloody about the heart. Those in large rivers and running water suffered less; almost all of those that lived in ponds and stagnant water died. Since that year, the Beaver have never been so plentiful in the country of Red River and Hudson Bay as they used formerly to be."

Man, doubtless, is the deadliest of this creature's enemies; but it is evident that epidemic disease is nearly as destructive in regions where the Beaver are abundant.

At 2 years, they are old enough to mate, but are not fully grown till $2\frac{1}{2}$ years old. They live for 12 to 15 years. Braithwaite thinks much longer. He says: "I feel safe in saying that he is liable to live to be 25 or 30 years of age."[123]

Sanitation and Scats

Like all creatures that live in colonies and have elaborate homes, the Beaver has progressed well along the lines of sanitation. At all times, the lodges are found scrupulously clean; for the owner invariably steps out-of-doors when prompted to void his ordure.

The style of the scat is shown in Plate LXXVIII (p. 631). It is like a roll of fine chips and wood fibres, of light colour, and little cohesion. It will be noted that Beaver dung is not found exhibited on rocks, etc., as is that of the Muskrat. My own observations confirm those of Hearne in explanation. He says:

"In respect to the Beaver dunging . . . they always plunge into the water to do it. . . . Their dung, being of a light substance, immediately rises and floats on the surface, then separates and subsides to the bottom."[124]

I searched in vain about the Beaver pen in Washington Zoo for some dung pellets for study. And the only perfect one I found at Yancey's Ponds, was that figured in the Plate of Scats. Others, reduced to a handful of woody fibre, were found along the dam; for, curiously enough, this is a favourite spot for deposit—perhaps on the principle that every little bit helps.

Furred and Feathered Foes

If we begin at the bottom of the scale, we may reckon the Muskrat as an enemy in the sense that he is a parasite, and does some injury to the

[123] Habits, p. 2.

[124] Journey, pp. 243–44.

dam. Dr. Richardson says: "The Muskrat frequently inhabits the same lodge with the Beaver."[125]

Eagles, no doubt, kill a few of the venturesome kits, although no record of such cases is at hand.

"The Lynx," says Braithwaite, "occasionally catches a small Beaver on the bank, but a full-grown one would be too many for him to handle."[126]

A proof of this appears in a remarkable incident furnished me by Thomas Anderson, Hudson's Bay Company Factor at Fort Smith. He says that a Desert Indian on the headwaters of the Gatineau, went out in the early spring, to look for Beaver. At a well-known pond, he saw a Lynx crouching on a log, watching a Beaver hole in the ice. The Indian waited. At length, a Beaver came up cautiously and crawled out to a near bunch of willows; the Lynx sprang, but the Beaver was well under way, and dived into the hole with the Lynx hanging to him. After a time, the Indian took a crotched pole and fished about under the ice; at last, he found something soft, and got it out. It was the Lynx drowned.

When the patient wood-cutter is wandering afar in the timber, the Fisher is another to be reckoned with, while the even more formidable Otter is ever ready to satisfy its hunger with Beaver meat, if no fish be at hand. According to Richardson, the Otter occasionally thrusts himself into the Beaver's lodge. He "is not always a civil guest, as he sometimes devours his host."[127]

As has been seen in the Wolf Life,[128] the Wolf also occasionally snaps up an unwary Beaver who ventures too far from his moat and castle.

In the Far North, the Wolverine is credited with being the most formidable natural enemy of Amik. Hearne says: "The Quiquehatches or Wolvereens are great enemies to the Beaver; and if there were a passage into their houses on the land-side, would not leave one of them alive wherever they came."[129]

But there is no such passage. And, since the enemy is not much at home in the water, we may wonder how the dry-land Wolverine can circumvent the web-footed Beaver. Only when the Beaver lands, and goes a-foraging, is he exposed to this foe's attacks. And land he must, nearly every day—or

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[125] Narrative, p. 92.

[126] Habits, p. 2.

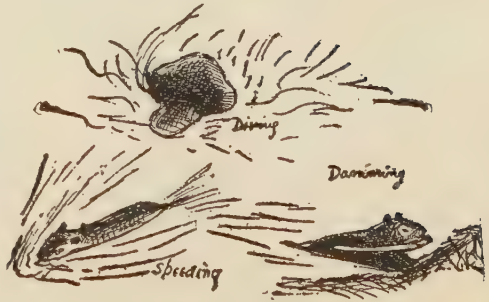
[127] Narrative, p. 92.

[128] Vol. I, p. 296.

[129] Journey, p. 231.

The largest chip I saw at the Yancey Ponds (life size); many were 6 by 1 inch, but most were shorter

Succession of attitudes in diving



Life sketches of Beavers at work

PLATE LX.—CHIPS AND SPLASHES

night—for fully eight months of each year. Then, when old Web-foot is far from the friendly pond, "the Wolverine lies in wait for him, and often cuts short his career."[130] So says Gen. D. S. Stanley, who lived at Fort Sully, Dak., in the '60's, and knew the Beaver in primitive condition.

The Blackbear might take his heavy toll of the Beaver but for the deep, safe-guarding moat. Henry Braithwaite says: "I have known a [Black] Bear to go down into four feet of water, and haul a Beaver out of a trap."[131]

Enos Mills adds the Grizzly to the list. Relating the fortunes of a certain Beaver colony that he watched all season through, he says: "One day, a harvester [Beaver] who ventured far up a shallow brook was captured by a Grizzly-bear."[132]

There can be no doubt that in the Rockies, the Mountain Lion is a Beaver foe of continual menace. Nevertheless, the following, related to Mearns by an Arizona prospector, shows that the Beaver does not lie down and surrender even when confronted by a Lion. The miner, from his camp on Colorado River, saw a Beaver crossing the sand, and a Mountain Lion crouched lying in wait for it. As the Beaver approached, "the Lion sprang upon it, and the two animals closed in a desperate conflict. The fortunes of war wavered, now on the side of the Lion, anon on that of the Beaver. . . . After fighting a long time, the Beaver was left dead on the field, and the Lion attempted to crawl from the spot . . . [but] soon lay down upon the sand and died from exhaustion and loss of blood."[133] It must have been a very big Beaver, and a very small lion; however, Mearns apparently accepted the story.

All of these enemies, with their yearly toll, were provided for in the Beaver "overhead." They made little impression on the Beaver hordes, and no sum total of diminution. The Beaver millions flourished till the white man came, with his ruthless all-destroying contrivances, and insatiable greed.

Lice and Louse-trap

The coat of the Beaver seems to be infested with a troublesome parasite. The captive specimens in zoos may often be seen nibbling each other for a quarter of an hour at a time; apparently, to give and get the joy of scratching on places not easily reached by the Beaver himself.

[130] Amer. Nat., II, 1868, p. 215.

[131] Habits, p. 2.

[132] Watched, p. 50.

[133] Mammals of the Mexican Boundary, 1907, p. 357.

In the plan of the Lost Creek or Yancey's Pond, it will be seen that many of the short pathways end at ant-hills; these hills are the work of a small and wholly black ant (species ?) that raises its mound a foot or so above the marsh. The Beavers may have sought these hillocks as lookout places; but there was evidence of their staying a long time. I wonder if they did not go there for what is known in the West as a "dry wash"; that is, to let the ants pick off the parasites.

Possibly, as noted already, the curious split or double nail on the second toe of the hind foot, is an adaptation for combating fur-lice. Since the purpose of the split nail is still under discussion, I offer further testimony:

Enos Mills, descanting on a Beaver family he kept under continuous observation, says of the mother as she hauled up on the bank one day: "She commenced to dress her fur—to make her toilet. After preliminary scratching and clawing with a hind foot, she rose and combed with fore claws; a part of the time with both fore paws at once. Occasionally, she scratched with the double nail on the second toe of the hind foot. It is only by persistent bathing, combing, and cleaning that Beavers resist the numerous parasites which thick fur and stuffy, crowded houses encourage."[134]

Later, he tells of the father Beaver cutting down a tree, and says: "While he was gnawing, a splinter of wood wedged between his upper front teeth. This was picked out by catching it with the double nails of the second toe on the right hind foot."[135]

Vernon Bailey's remarks are even more detailed. He says: "The two inner toes, however, curve toward the body; and the nails are highly specialized, and have been called *combing claws* and *louse-catching claws*. The inner toenail is the less specialized, but consists of a long, double-edged nail that clamps down over a long, soft lobe, opening and closing like a duck's bill. The second toenail has caused much speculation, and is often called the *double-nail* or *split-nail* of the Beaver. Between the lobe of the toe and the real nail, is a horny growth with a sharp, finely serrate upper edge, over which the real nail fits down with its two sharp lower edges when pressed down, and opens up slightly when the pressure is removed. This could be called the fine-toothed comb, while the inner toe-nail is more of a coarse comb in effect.

"Never until I had tame Beavers to study, did I fully understand the use and structure of these peculiar nails, nor the reason for the incurving form of the two inner toes. My young Beavers would sit and comb their fur for a half hour at a time, making elaborate toilets when they had nothing

[134] Watched, p. 52.

[135] As above, p. 56.

PLATE LXI.—BEAVERS IN WINNIPEG ZOO

The lowest figure at the left shows a Beaver carrying mud on its tail
Photographs by E. T. Seton

else to do. The curved finger nails of the hands were used on certain parts of the body, around the breast and head, the base of the tail, and especially in the short hair around the anus, where the oil from the two oil glands is caught and held for distribution. These finger nails were simply raked through the fur in a coarse combing and oil-distributing process, preliminary to the final, thorough combing with the hind feet. Then, with one foot at a time, the sides, shoulders, and belly were systematically gone over with inward, rotary strokes of the two double claws of the hind toes, until every kink and snarl of the fur was straightened out, and not improbably, as Seton suggests, any mites or insect parasites combed out and off. [*Life-histories*, 1909, I, p. 447].

"At any rate, Beavers are singularly free from parasites, two small brown beetles (*Leptinillus validus*) being the only ones discovered on four old Beavers taken for specimens in Wisconsin. No parasites of any kind were found on the 6 young Beavers kept in captivity, although all did much combing. Unquestionably, the early and constant use of these claws for thousands of generations has perfected their present form and adaptation; which might even suggest improved methods of caring for dressed furs."[136]

The Beaver's Little Brother

Quite a diversity of opinion prevails regarding the attitude of the Beaver toward his little brother, the Muskrat.

Richardson says: "The Muskrat frequently inhabits the same lodge with the Beaver."[137]

Apparently, the Beaver views the Muskrat as an enemy. It enters the Beaver pond as a sort of parasite, and works mischief there, as elsewhere, by piercing the dam with its tunnel. The trappers generally maintain that the Beaver recognizes the Muskrat as a mischief-maker, and kills it when the chance occurs.

Enos Mills offers some illuminating remarks: "I had often heard," he says, "that Beavers ever war upon their little brother, the Muskrat. The Beavers in this colony did not. They continued to use the old repaired house, until near the close of their harvesting. On their departure, apparently Muskrats at once took possession. But the Beavers often went back into the old house.

"One day, I saw a Beaver enter the house. There were a number of Muskrats inside. I do not know the nature of his visit, but there was no

[136] The Combing Claws of the Beaver, Journ. Mamm., May, 1923, p. 78.

[137] Narrative, p. 92.

excitement. Another time, a Beaver turned aside, and touched noses with a Muskrat. Still another time, a Beaver playfully dived beneath a Muskrat. As the Beaver came up, the Muskrat grabbed Beaver fur with fore paws, and sat down on the Beaver's back. Away swam the Beaver with back above the water, little brother holding on."[138]

To Scatter a Mob

The blackbirds that frequent the Beaver pond, and find safe nesting places in the willows, may be considered modest parasites of the Beaver, much as were the jackdaws perching about and nesting in the feudal baron's castle. The blackbirds do not realize their debt to the Beavers; their ill-behaviour toward their benefactors in the Yancey colony at times constituted a nuisance.

The patriarch and chief toiler in the big pond, while attending strictly to business, was continually pursued by the Brewer blackbirds that nested in the near-by swamp—*his* swamp, made by *his* efforts. They were very inconsiderate, ungrateful, and resentful birds, ready to annoy any creature that came near their home ground. Without regard to law or order, age, rank or prior claim, they again and again united in a noisy mob to tease the old Beaver as he calmly swam across his own pond. But sturdy old Amik found a simple way of dispersing the mob, one that I would commend to the notice of our city authorities. When tired of the annoyance, he gave a flirt of his tail that sent up a shower of spray on his tormentors, and drenched them so thoroughly that they were glad to go back to the bushes and mind their own business.

As an Irrigator

The Beaver's services as a water conservator are not fully appreciated. George B. Grinnell tells[139] of a little valley in Montana where to-day the Beaver are numerous, although the region about is trapped out. The settler on whose land it is, protects the Beaver colony rigorously.

"The reason that these Beaver are protected," says Grinnell, "is that the man who claims this water and the adjacent hay meadow, realizes that in the Beaver he has a lot of unpaid servants, who, by their work, are saving him a great deal of labour and of money. They have dammed this creek, and have thus put under irrigation the meadows from which he cuts his hay. If he were short-sighted enough to tear up these dams and to kill these

[138] Watched, pp. 136–37.

[139] Forest & Stream, Jan. 19, 1907, p. 95.

Beaver, he would be obliged to go to the head of the stream, and there take out a ditch, bring it around along the hillsides, build laterals and sub-laterals, and so get water on his hay meadows at considerable expense. Now, that meadow is sub-irrigated throughout its whole length, receiving just the amount of water that it needs; and all this without one cent of cost to him who cuts his hay there."

Many a dry farmer in the West is now utilizing the Beaver's services in this way. I am in hopes that this setting forth of the method, will result in many others adopting it. It gives a new interest and a new value to the Beaver.

Beaver and Trout

The Beaver dam turns the rill into a succession of pools, cool and deep. In these, the trout find safety, especially when, in dry times, the rill ceases to run. They seem to recognize the Beaver as friend and protector.

This story is told by W. C. Vogt, and appears in *Field & Stream*, March, 1921, p. 1004: For several evenings he watched some trout in a pool below a little fall. They were, he says, "lying directly under the belly of a large Beaver. . . . I'd step out from behind the bushes, and they would disappear, but return in a few moments; they didn't seem to pay any attention to the Beaver until I made a cast and hooked the Beaver in the ear with my fly. When he felt the sharp point of the hook, the old boy slapped the water so hard it sounded like a man striking the water with a paddle with all his might. You should have seen those trout go, also the Beaver. He straightened out the fly hook, but came back again in ten minutes, the trout with him.

"Seemed to me the trout were sort of guided by the Beaver's actions. I gently laid the leader across his head, and he shook his head like an old bull. I struck and hooked his ear; again he made a plunge, and splash that looked as though a small cannonball struck the water. The trout went with him again; and in about twenty minutes, he returned, the trout with him—six beauties. I made another cast, across his tail, and struck; and I thought sure he had broken my rod, but found he had again straightened out the fly hook.

"I waited half an hour or so, but he never came back. It was getting dark, and I was sort of sorry I broke up his trout party. I'll always remember his big eyes, like big, brown, glassy marbles. I saw several [Beaver] climbing over a dam a little distance up from where I stood, and maybe he was among them. There are thousands of men who believe that Beaver catch and eat trout."

The Chain

Darwin is credited with saying that the fertility of the clover crop in a given region depends on the number of old maids there. The clover relies wholly for its fertilization on the bumblebee; the bumblebee's deadliest enemy is the Field-mouse; the Field-mouse finds his effectual check in the Cat; and the number of Cats depends on the number of old maids. Q. E. D.

Such unexpected yet undeniable chains are discoverable in the animal world, if we look for them. Thus, I have heard Dr. Robert T. Morris hold that cotton overalls had multiplied the Caribou in Labrador. How? Simply thus: Cotton clothing, brought by the white-men, was so cheap and strong that the natives gladly traded off the valuable Caribou skins that should have afforded them weatherproof clothing, and adopted cotton garments. But wet overalls are a fruitful source of colds, and the natives were so prone to lung trouble, that the cotton clothing proved devastating. The hunters especially were stricken; and, in the resultant decline of hunting, the Caribou prospered.

Indian wars, freaks of fashion, new uses, have each in turn had a bearing on the animal whose product was involved. In the case of the Beaver, its fur was so much in demand in making the necessary beaver hat of respectability, that the creature seemed doomed. Then respite came from the discovery that silk made a better looking hat; so silk hats took the lead, and, for a time, the Beaver was reprieved.

The Moated Castle

There is one aspect of the Beaver lodge that deserves the full and careful attention of some trained naturalist, that is, as a moated citadel, the home of a community.

The baronial castle of the Dark Ages, was, first of all, the moat-surrounded, thick-walled dwelling place of the manor-lord and his family. But so many other weaker persons were eager to seek his protection, that each castle became an ever-growing community, comprising the strangest and most diverse types.

This is exactly the case of the Beaver lodge. First, the great over-lord and his family build their strong fortress, of reinforced concrete—that is, sticks and hardening mud—and, at the same time, they dig and dam till the deep moat is all about it.

The moat entirely changes the aquatic life. New plants, new fishes, new insects are attracted. The top of the lodge furnishes a secure nesting place for wild geese, wild ducks, divers, grebes, etc.; the hollows in the great

The Cataract of NIAGARA. some make this Water Fall to be half a Leagüe while others reckon it no more than a hundred Fathom.
A View of ye Industry of ye Beavers of Canada in making Dams to stop ye Course of a Rivulet. in order to form a great Lake. about wch they build their Habitations. To Effect this; they fell large Trees with their Teeth, in such a manner as to make them come Crosß ye Rivulet; to lay ye foundation of ye Dam; they make Mortar. work up, and finish ye whole with great order and wonderfull Dexterity.
The Beavers have two Doors to their Lodges, one to the Water and the other to the Land side. According to ye French Accounts

PLATE LXII.—OLD PRINT OF BEAVERS

This old plate embellishes a map of the British Dominions in North America, 1715. It portrays current notions anent the beaver, and is also the earliest known picture of Niagara Falls

walls afford refuge to Water-shrews, snakes, Mink, and Muskrats. Fish lurk in the dungeons below, while insects, of kinds all too many, flourish in the wall, the roof, and the bedding.

The full story is worth a summer's work at least. Where is the young naturalist who will set forth in full this untold fairy tale?

Place in History

First known, best known, and most important historically of all the big animals in America, is the Beaver. More than any other, it changed the course of history; more than any other, it has been studied and discussed. The bibliography of the Beaver far exceeds that of any other of our animals. It is the only species that has been made the subject of half a dozen monographic works.

In view of this, it seems presumptuous to treat in 50 pages what others have done so much better in whole volumes. Therefore, let this be considered rather a résumé of the subject, with references and appraisals of its extensive literature.

The earliest known game law in America was established by the Redmen for the protection of the Beaver. From Samuel G. Drake's "Indian Biography" (1832, p. 111), we learn that in 1684, De la Barre, Governor of Canada, complained that the Iroquois were encroaching on the country of Indians who were allies of the French. He got a stinging reply from Garangula, the Onondaga Chief, and a general statement that *the aborigines had game laws;* not written, indeed, but well known, and enforced with a club if need be: "We knock the Twightwies [Miamis] and the Chictaghicks [Illinois] on the head, because they had cut down the trees of peace, which were the limits of our country. They have hunted Beaver on our lands. They have acted contrary to the customs of all Indians, for they left none of the Beavers alive, they killed both male and female."

For four hundred years, we pursued the defenseless Beaver with ruthless extirpatory slaughter. Fortunately, before the consummation of our reckless activity, we have wakened up; we have realized the gravity of the impending loss. We have become almost as advanced and far-sighted as the Redmen were 300 years ago; and have enacted protective laws that will insure to us a supply of Beaver for the indefinite future.

There can be no doubt that the Beaver did more to open up Canada than any other creature or product. It was the pursuit of the Beaver that lured on the early explorers, and that brought here the original colonists.

It was Beaver fur that bought for white-men the manufactures of Europe which were needed to make life tolerable, when first our people took to the woods. It is fitting indeed that this creature, the symbol of energy, peace, and industry, should be the emblem of the Canada for which it did so much.

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[140] F. B. A., I, pp. 108–09.

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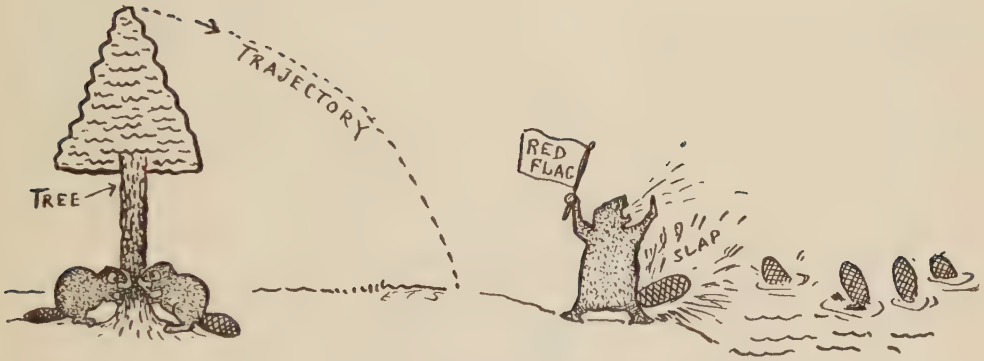

LIFE LXXXVI—THE PACKRAT

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Packrat, Trade-rat, Mountain Rat, Cave-rat, Wood-rat, Bush-rat, Bushy-tailed Rat, Mound-builder, Drummer-rat

Neotoma cinerea (Ord)

(Gr. *neos*, new; *temno*, to cut, in allusion to the teeth; L. *cinerea*, ashy)

Mus cinereus Ord, 1815, Guthrie's Geog., 2d Amer. Ed., II, p. 292.
Neotoma cinerea Baird, 1857, Mamm., N. A., p. 499.

Type Locality—Near Great Falls, Cascade Co., Mont.

Hopi, *Kee-huá Cahl'-a*.[1]

The name "Packrat" is, of course, from the Western word "pack," meaning to "carry" or "carry off." "Trade-rat," referring to its habit of leaving something in place of the alluring object it carries off, is explained in the section, "As Trader."

The genus *Neotoma* (Say & Ord, 1825) is composed of rodents of ratlike size and form, with more or less hairy tails, and peculiar teeth.

$$\text{Teeth: Inc. } \frac{1-1}{1-1}\text{; mol. } \frac{3-3}{3-3} = 16$$

Major E. A. Goldman's Revision of the Wood-rats[2] recognizes 70 species and subspecies. These he groups into 3 subgenera—*Neotoma*, *Homodontomys*, and *Teonoma* or, in English, Roundtailed Wood-rats, Dusky-footed Wood-rats, and Bushy-tailed Wood-rats or Packrats.

The last is the best known, the largest, most clearly marked, and most widely distributed; so may represent the group, since, in their habits, they closely resemble each other.

In addition to the generic characters, the Packrat has the following:

Size. Length, $15\frac{1}{4}$ in. (387 mm.); tail, $6\frac{3}{8}$ in. (162 mm.); hind foot, $1\frac{11}{16}$ in. (43 mm.).

[1] Mearns, Mamm. Mex. Bd., p. 479.

[2] N. A. F., 31, 1910.

Weight. Two females taken in New Mexico, Jan. 27, 1894, weighed each ½ lb.

Colour. The first impression is of a warm buffy brown animal, with snowy-white breast and underparts, and bushy gray tail.

In general, above, soft buffy-brown, faintly but thickly lined with dark tips. The buff becomes clear and deeper on shoulder, flank, and ham, but paler on face. Lips, throat, underparts, paws, and underside of tail, creamy white. The upper surface of tail is dark gray. The central area of belly, 4 in. long by 1½ in. wide, stained yellowish with the musk. The longest whiskers are 4 in.; they are black and white mixed. The ear is dark gray. The eyes are large and black.

The young are much less buffy, more gray; also the underfur on their belly is plumbaceous instead of white.

The female is like the male, but without the musky stain on the belly. The teats are 4, all inguinal.

The bushy tail is a strong feature, distinguishing it from the Round-tailed group, and the Dusky-foots.

Races

cinerea Ord, the typical form. T. l., near Great Falls, Mont.

lucida Goldman, like *cinerea*, but smaller and paler; smallest of all the Packrats. T. l., Charleston Peak, Clark Co., Nev.

drummondii Richardson, like *cinerea*, but fur longer, tail bushier; and the dark colour of the fore legs ends sharply at the wrists. T. l., Near Jasper House, Alta.

saxamans Osgood, like *cinerea*, but much darker, and with much bushier tail. T. l., Bennett City, B. C.

occidentalis Baird, like *cinerea*, but darker, and ankles more dusky. T. l., Shoalwater Bay, Pacific Co., Wash.

fusca True, like *cinerea*, but much darker and woollier; ears smaller; top of foot, dusky; tail bushy, and not white below. T. l., Fort Umpqua, Douglas Co., Ore.

orolestes Merriam, like *cinerea*, but more ochraceous; larger than the two following. T. l., Saguache Valley. Saguache Co., Colo.

arizonæ Merriam, like *cinerea*, but much smaller, and more ochraceous; tail less bushy; paler and smaller than *orolestes*. T. l., Keams Canyon, Apache Co., Ariz.

rupicola Allen, like *cinerea*, but smaller and paler; tail, shorter. T. l., Pine Ridge, S. D.

Range and Haunts

Map XIV (p. 507) is based on Goldman's maps in the Revision. It shows that this is essentially a mountain Rat, infesting the upland region of the Rockies, from Colorado and California to Yukon; and extending its possessions southward along the Sierra Nevada of California, also into Arizona and into New Mexico; where high, cold cliffs or canyons carry the Canadian conditions into the Transition Zone. It does not reach the upper limit of the Canadian.

In all this vast range, it is found wherever there is a combination of trees or bushes, rocky cliffs, rock slides, caves and crannies, near water and evergreen trees. In its haunts, it is essentially ratlike, rather than squirrel-like, although there is much of the latter in its habits.

Fortunately, it does not frequent towns; and the only encroachment it makes on the abodes of man is among lonely ranchhouses and in miners' cabins.

Abundance

Various writers describe the creature as "abundant," "plentiful," and "common everywhere."

When at Victorville, Calif., Feb. 13, 1923, I rambled over the 50-acre tract to the east of the ranchhouses, and noted a Packrat house about every 30 feet; that is, 1 to 1,000 square feet, which would mean about 40 to the acre. This was doubtless *fuscipes*, as it was on the Mohave Desert.

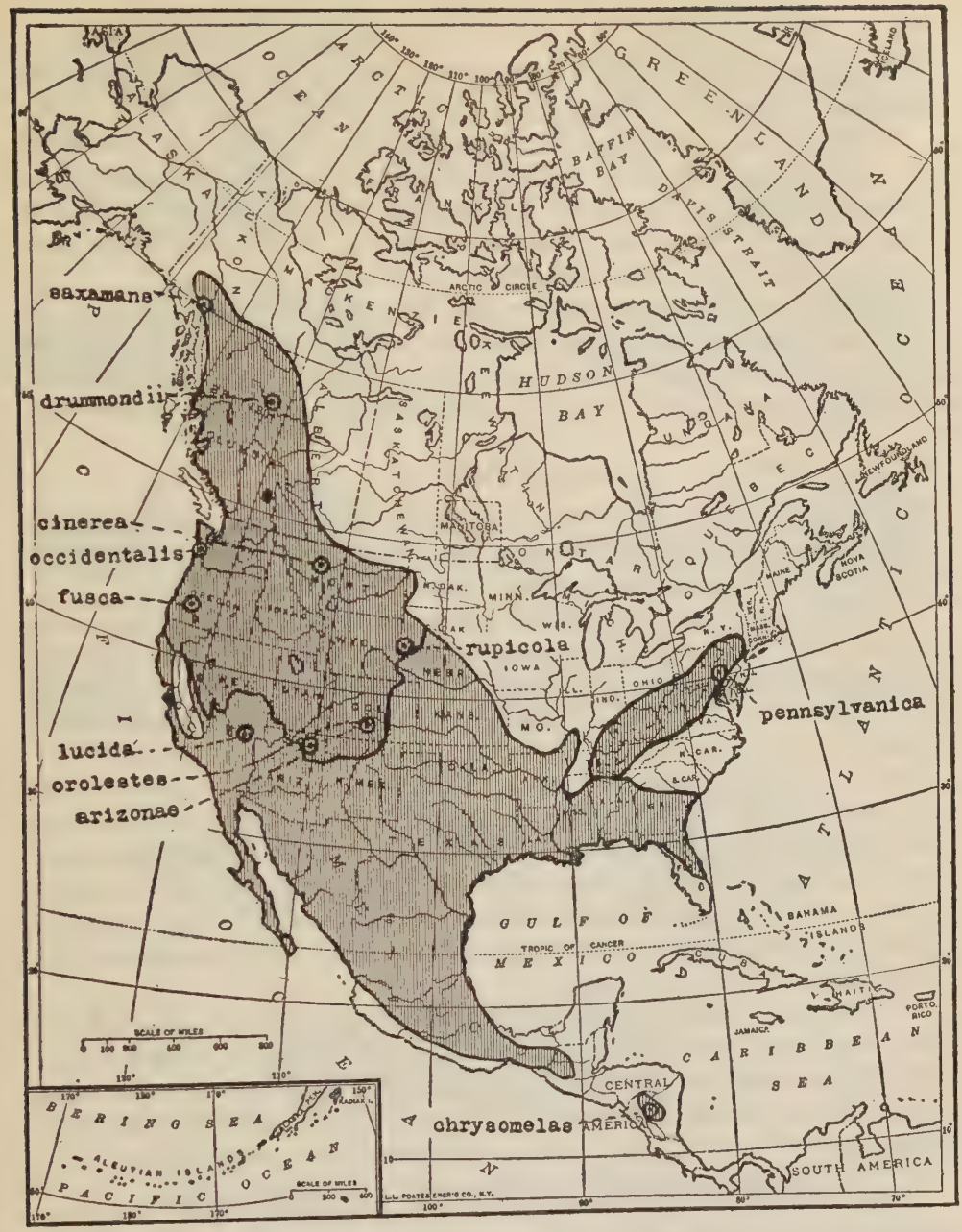
In the region about Clayton, N. M., I found the local species (*albigula*) nearly as common. The masses of rubbish, as high as a man, were visible in all directions, sometimes as many as a dozen to the acre.

Erratic Migration

The species is supposed to be stationary throughout its range. Doubtless, it is so, in the ordinary sense; but there is evidence of the same sort of erratic migration as appears among Gray-squirrels, Lemmings, etc. Such movements are sometimes called "drifts."

Referring to the species in Oregon, A. W. Anthony says: "By far the most interesting 'drifter' is the Western Bushy-tailed Wood-rat (*Neotoma cinerea occidentalis*). There would seem to be an extensive and regular movement of this species, beginning each year in early July, and extending over a period of about five weeks.

"In 1912, I trapped 25 Rats in my barn in some three weeks; and then resigned in favour of my son, H. E. Anthony, who soon extended the record to 40. At no time was there evidence of more than 2 or 3 Rats on the place;



MAP XIV.—RANGE OF THE ROCKY MOUNTAIN PACKRAT (*N. cinerea*) AND ITS ALLIES

By E. T. Seton, with assistance of the Biological Survey, 1927

The Packrats of various species are found in all of the tinted area.
The Bushy-tailed or Mountain Packrat in various forms is found in the mountain region of the Northwest, here heavily tinted.

and after the last was captured, some time in August, I think there were none seen until the following July.

"In later years, I noticed one or two Wood-rats at about the same date; and a steady movement was noted until about the middle of August. If a pair were trapped, it was seldom over 24 hours before more appeared; but it was seldom, if ever, that we were annoyed by their depredations after their movements had ceased in August.

"At the time these movements take place, food is still to be had in its usual abundance; and the mating season has long since passed. It would seem to be chiefly an instinct to seek new habitats before winter shuts them in, and one which serves as a check on consanguinity and its evil effects."[3]

Packrat Broth, Etc.

Of the Packrat's flesh, all speak in praise. Despite the musky smell of the living animal, the flesh is delicate and sweet, and has long provided a staple of diet to many of the human residents of its range.

Thus Mearns says: "Indians kill and eat them. The Hopi . . . pronounce its flesh a delicacy. Captain Martinez, of the army engineers corps of Mexico, informed me that physicians of northern Mexico commonly order broth made from the Wood-rat for the Indians and peasants, whom they are called upon to treat; just as our physicians prescribe chicken broth and beef tea."[4]

So also Nelson writes: "They are persistently hunted as game by the [Mexican] natives, who prize them as a special delicacy. I saw them regularly sold in the markets of the cities of San Luis Potosi and Aguas Calientes, where the method of marketing them was unique. As soon as they were dug from their nests, their lower incisors were broken off close to the jaw to render them powerless to bite; and then the Rats were placed alive in a strong sack and carried to town.

"The vendor would sit on the curb of the market, and either kill and dress them there, or shout his wares by telling everyone who passed that he had 'country Rats; very delicious; live ones; fat ones; very delicious; very cheap.' The natives all praised their delicate flavour; and one I had served me as a special courtesy, was really good, tasting like young Rabbit."[5]

Although his fur is soft and warm, as well as of pretty colour, it has not yet established a place for itself in the world of commerce. Doubtless, it will not be overlooked much longer, if it can be obtained in quantity; since

[3] Journ. Mamm., Feb., 1923, pp. 60–61.

[4] Mamm. Mex. Bd., p. 479.

[5] W. A. N. A., p. 517.

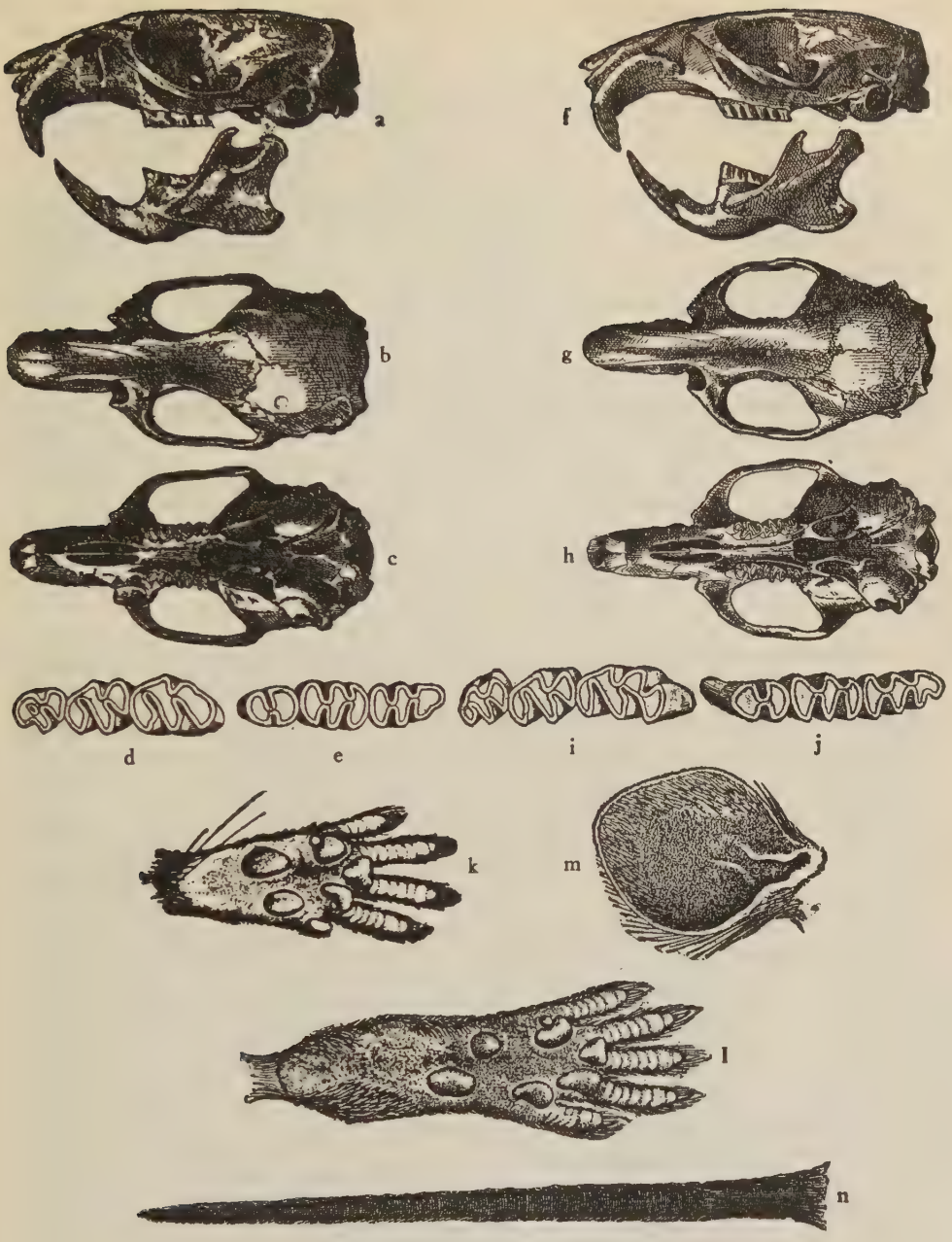


PLATE LXIII.—SKULLS, ETC., OF NEOTOMA

(a, b, c) Skull ½ of *Neotoma cumulator;* (d, e) teeth of same, $\frac{3}{1}$. (f, g, h) Skull ½ of *Neotoma pinetorum;* (i, j) teeth of same, $\frac{4}{1}$. *N. fuscipes macrotis* (k, l) Feet, $\frac{2}{3}$; (m) Ear $\frac{1}{1}$; (n) Tail $\frac{1}{3}$.

These cuts are from Mearns's *Mammals of the Mexican Boundary*, and supplied by the U. S. National Museum

every kind of peltry known—Cat, Rat, Rabbit, Colt, or Calf—is used; provided only it have some hint or semblance of fur.

His Foes

Every predaceous bird and beast in his region preys on the Packrat. Wildcat, Lynx, Coyote, Wolf, Badger, Skunk, hawk, and owl, lose not a chance to banquet on his tender flesh.

Speaking of the White-throated species, Mearns says: "Hawks and owls also devour this Rat. A Western red-tailed hawk, taken Jan. 16, 1887, at Fort Verde, had eaten one, swallowing it, bones, hair and all. Barn-owl pellets from a nest in the bluff clay bank of the Verde River, on July 30, 1885, contained bones of this Wood-rat."[6]

Bailey says: "The skulls are among the commonest bones recognized in pellets under the cliffs where the great horned owls roost."[7]

On Aug., 16, 1927, when camped at Laguna, N. M., Carol Stryker and myself found a number of horned owl pellets composed of Packrat bones and fur.

From most of these foes, he is secure in his piled-up, spiny, barricaded nest. Yet there be one or two who can take the castle by invasion or assault. Leaving out man, the Badger and the Bears are the only creatures strong enough to tear down the cactus battlements of Kee-hua's castle; but so far, we have no testimony that they ever face this serious task.

The Weasel and the snake can take it by invasion. There is not a definite record at hand of slaughter by Weasels; but many naturalists bear witness to the toll taken by snakes.

Discussing a nest of *fuscipes* that was on a rocky ledge in Santa Cruz Mountains, Calif., Harold E. Parks says: "One of the occupants was a very long, slender snake—probably a California striped racer—which proceeded to race back and forth through some brush, but I could not make it leave the vicinity of the nest. It is said that rattlers sometimes use these nests; but although I have had some painful experiences in trying to prove it, I have never found the rattler in the nest. If the rattler occupies the nest, he also eats the Rats."[8]

Mearns adds: "On Aug. 15, 1886, at Fort Verde, the First Sergeant of Company K, Ninth Infantry, brought me a diamond rattlesnake weighing $4\frac{9}{16}$ pounds, which contained a Wood-rat."[9]

[6] Mamm. Mex. Bd., p. 479.

[7] Texas, p. 112.

[8] Santa Cruz, p. 247.

[9] Mamm. Mex. Bd., p. 479.

PLATE LXIV.—FLORIDA RAT

That the snake does not have an assured or easy victory, is attested by Prof. Carl Hartman, of the University of Texas, who says: "Sometimes possession of the nest is successfully disputed by rattlesnakes, which formerly infested the Driscoll Ranch (now in cultivation) 25 miles southeast of Austin, where the observation was made. Mr. [Charles H.] Hamby describes the Rat as the chief aggressor in the battle witnessed by him. The snake never struck, but confined its activities chiefly to attempts at escaping. It would coil up while the Rat would stalk round and round, until a favourable opportunity presented itself; when the Rat would pounce upon the coiled mass and bite furiously. Thereupon, the snake would attempt to escape, only to coil up again for defence. This procedure was repeated until the snake collapsed; and even after this, the Rat bit the snake a dozen times before leaving the field of battle. During the fight, both snake and Rat seemed perfectly oblivious of the observer's presence."[10]

Something like an armed neutrality is hinted at in Cope's comment. After discussing the Prairie-dog as a home-provider for the rattlesnake, the Professor adds: "In some regions, the Wild Rat, *Neotoma*, does the same service. I well remember a large *Crotalus* which dwelt in apparent harmony with a Rat and her family near a camp north of Clarendon, in the Panhandle of Texas. Both the snake and the Rat were fat; but no young Rats were in sight."[11]

Warbles

The Packrat would be alone in his Family if he escaped the pesterment of the bot-fly. Edmund C. Jaeger, of Riverside, Calif., says: "On March 2, 1924, I caught a male in a box trap, and found him to be the host of larval bot-flies, as evidenced by great blisters on the back and sides of the abdomen. The larvæ at this time, were just about ready to emerge, and drop for pupation. The animal, formerly very fat, seemed considerably reduced in weight; but was very active. Three weeks later, I caught a female; and scars indicated that she had previously had 'warbles' too."[12]

Sociability and Signalling

There is much evidence of well-developed sociability among these animals. Parks says of the White-throated species: "They appear to be sociable by nature. In one case, I found evidence of two families occupying one large nest. Frequently, hard and well-worn paths will be found leading

[10] Journ. Mamm., May, 1922, p. 117.

[11] Ann. Rep. Smiths. Inst., 1900, p. 1173.

[12] Journ. Mamm., Nov., 1924, p. 268.

from one nest to another, indicating intercourse between them. Usually the nests are to be found in colonies, isolated nests being exceptions."[13]

Drumming as a mode of signalling or of expression is practised by many animals; for example, Deer-mice, Rabbits, and Hares. But it would seem that the Wood-rats have developed the method more highly than most of those mentioned.

Merle F. Bancroft says of the British Columbia species, as he saw it near Ashcroft, "I was sleeping on a camp cot; and, in the gray dawn, heard a rapid beating on the board floor beneath my cot. Quickly ducking my head over the side of the cot, I got my first close-up glimpse of a Wood-rat. . . . This particular Wood-rat had become adept in drumming on a board floor. The noise produced was far louder than ground drumming."[14]

Nelson also testifies that Wood-rats "express annoyance or alarm by a rapid drumming on the ground with the hind feet."[15]

Like White-footed Mice and blacksnakes, they are known at times to drum with their tails also.

The species is noted for its strong, musky smell. A. Brazier Howel found on the belly of the male an area about $1\frac{1}{4}$ inches by 3, occupied by sebaceous glands, the source, no doubt, of the musky smell; but he did not find them in the female.[16] Such muskiness is usually considered part of a system of communication; being used either as a property-mark, a sign-board, or a wireless call. Nevertheless, no observations are yet at hand to show that it serves the species in any of these ways.

Bailey says: "A strong, musky odour, characteristic of the genus, is the usual indication that the dens are inhabited."[17]

Disposition and Habits

A singular combination of shyness and boldness, courage and timidity, cunning and simplicity, are seen in the character of the Packrat. But the shyness and timidity and simplicity are dominant, warning us that, in the long run, this interesting species must give place to the fierce and crafty Brown Rat of Europe.

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[13] Santa Cruz., p. 244.

[14] Can. Field Nat., May, 1922, p. 87.

[15] W. A. N. A., p. 517.

[16] Anatomy of the Wood-rat, 1926, pp. 16–17.

[17] Texas, p. 114.

All of the group can climb well, but *fuscipes* is more at home in the trees than its kinsfolk. Of this, Parks says: "On the ground, they were slow of movement, but were much speedier in the trees. Aloft in the trees, they were not inclined to run far or escape when observed. They would stretch their bodies lengthwise along a limb without much attempt at concealment, and then follow every movement of a person on the ground with their eyes. Unlike the Squirrels, they do not seek to keep the tree between themselves and an observer. When shot at with a rifle, they would sit up on their haunches, and squeal; but make no attempt to run away."[18]

"One morning," he continues, in discussing the species, "while at an early breakfast, under the trees at my camp, I noted a considerable commotion in the branches overhead. A half dozen small animals were running back and forth at play, unconscious of or unconcerned at my presence. I did not attempt to destroy them at this time; and in several days, they became quite tame, showing no fear of any one around the camp. They appeared regularly morning and evening; and quite frequently came down to the ground for bits of food.

"To me, they appeared quite stupid, and rather sluggish in movement. They did not move with any great speed; and such of them as I have seen at distances from the nests, did not take alarm very easily. It may be that their great curiosity overcomes fear to a certain degree.

"Eventually, these little visitors became such a nuisance that the rifle was brought into use. Sitting at my table, I shot 6 of them as they sat in the branches of the tree above me. They made no effort to get away, simply squealing a little at the noise, but otherwise appearing quite unafraid. They presented a ludicrous and helpless appearance.

"They were all apparently dwellers in a nest located in a large oak at some little distance from the camp. I could trace their course of travel through the trees from that vicinity. I have since seen regular courses travelled by Rats through the madrone thickets, regular paths being worn in the tender young green bark early in the fall."[19]

The Secrets of His Mound

The outstanding, visible, and omnipresent evidence of the Packrat's presence is the nest. This is a vast and growing pile of sticks, stones, leaves, pine cones, cactus, thorns, bones, cow-dung, bark, rubbish, and trash galore. The Rat weighs half a pound; the mound weighs half a ton.

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[18] Santa Cruz, p. 243.

[19] As above, pp. 242–43.

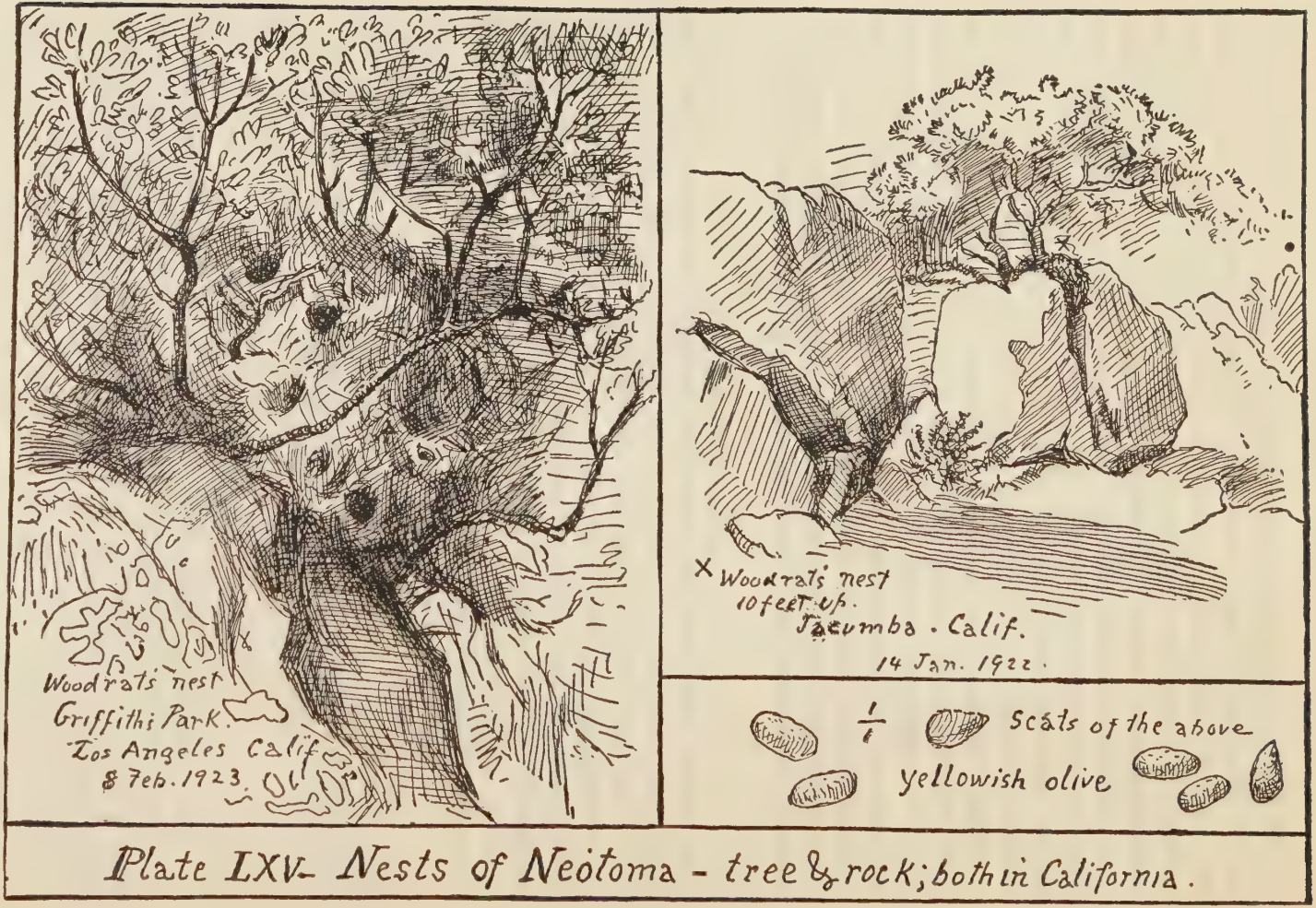

Plate LXV- Nests of Neotoma - tree & rock; both in California.

The cactus or other spines are a dominating feature of the mound. They fringe and protect it everywhere, and are especially thick and dangerous around the doorways, as we know to our cost whenever trying to force an entrance.

Bailey says: "How the Rats can run over these houses and along the trails strewn with cactus spines, and never show a scratch on the bare, pink and white soles of their feet, is a mystery."[20]

In the centre of this mound is the real nest—a long chamber about 5 inches across and 3 high. It is lined, roofed, and floored with a mass of the finest available shreddings—usually chewed cedar bark—but also some hay, hair, feathers, and fur, with cotton and rags when available.

The outer walls may be rugged and spiney, but this innermost sanctuary is always a model of cosiness and soft comfort.

There are several entrances, most of them visible and aboveground; but the prudent mound-builder always has a cyclone cellar into which he can retreat in times of unusual stress.

Speaking of the large nests of *fuscipes*, Pennoyer F. English says that they vary from 2 to 8 feet both in height and diameter; these "large nests . . . are divided into as many as 5 compartments, these being used as nursery, living room, and storage chambers—and one place is used for the depositing of dung. The inner compartments are connected by a series of runways."[21]

The nest of the Packrat, like the dam of the Beaver, is never finished. As long as he lives there, the sedulous little one keeps piling on new material; and he will live there as long as fate lets him. Not a night passes without additional sticks and rubbish being added; so that, as the years go by, the nest becomes a little mountain composed of a ton or more of trash.

The Horror of Wild Fire

There is one menace to the nest and to the Rats, that has always loomed large, as far back as history goes—whether before that, is uncertain. That menace is wild-fire. In seasons of drought, the fires which sweep the forest and mesas of the Southwest, find a ready-made pile of kindlings in the dry, upstanding nest of the Packrat. In a few minutes, the mound is converted into a glowing pile of coals, with smoke and scorching breath ascending.

Hunters often take advantage of this combustibility to drive the Rats into view for capture. Parks says: "These piles of dry sticks were like so

[20] Texas, p. 112.

[21] Dusky-foot, p. 2.

much tinder; so I fired them, the surrounding vegetation being wet and green enough to prevent fire from spreading. Fire was applied at the top, and burned rapidly downward. As they were fired, one at a time, I watched for the fleeing Rats, but saw none. The occupants took to underground passages";[22] prepared for just such an emergency, and so escaped.

Home Love

The affection that the Packrat has for his castle, is reflected in these observations by Parks: "On occasion," he says, "I have disturbed Rats [*fuscipes*], and forced them into the trees, where I have thrown sticks at them with the intention of making them move rather than to injure them. If the missile passed close enough, the Rat would move a short distance, and wait for another missile to be thrown. The result almost invariably was that the Rat would travel in a circle that kept it in close touch with the nest. If the nest was destroyed, the Rat could then be driven away immediately, usually to a small refuge nest high up in the trees."[23]

This same observer says further: "The Rats are not satisfied with the underground retreats, for they build small refuge nests high up in the trees in the vicinity of the ground nest. When driven from the safety of the latter, they will take to the trees, and finally seek the shelter of the tree nests. A sudden sharp blow upon the ground nest will frequently scare a Rat into the trees; and on rare occasions, one will go directly to the tree nest. More often, the Rat will remain in the vicinity of the main nest until compelled by force to leave it."[24] Elsewhere he tells of driving the Rats out by burning the nest, and adds that they hid during the fire, but "later came forth and proceeded to rebuild. In a few days, the nests were well under way, and assuming good size. Had a general fire run through the brush, they would have deserted the locality for an unburned site. I have recently (1919–20) witnessed extensive burnings of brushy areas to rid a neighbourhood of Rats; and within a month, many new nests were in process of construction a very short distance from the burned area."[25]

Writing of the White-throated species, under similar fiery visitation, Mearns says: "They were usually very reluctant to leave their habitations, and many were severely singed before they would forsake their domiciles."[26]

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[22] Santa Cruz, p. 242.

[23] Santa Cruz, pp. 243–44.

[24] As above, p. 246.

[25] As above, p. 242.

[26] Mamm. Mex. Bd., p. 478.

The Mating and Breeding

At Clayton, N. M., I found a female in rut, Jan. 27, 1894.

Speaking of *fuscipes*, English says: "The female mates with a single male, and there is no evidence of polygamy. After mating, the male becomes a hermit, and lives alone in a separate nest which he constructs himself. This nest is small, and usually built in a tree."[27]

The same writer continues: "Wood-rats bring forth their young in the spring, from February to May. The mother is equipped with 4 mammary glands, which are squarely placed, and in the same relative position as on our domestic Cow."[28]

The brood numbers from 2 to 6, with 3 as the usual.

"Seventeen days after birth," says English of *fuscipes*, "the young open their eyes; and weaning takes place at approximately three weeks of age. After weaning, the young, by example of the mother, begin to eat the same green foods."[29]

Though the species is monogamous, the father seems to take no active interest in the young; but the mother, by her devotion, more than makes up for any shortcomings on his part.

Merle F. Bancroft tells us at length of a Packrat that he camped with in the Selkirk Mountains of British Columbia. On July 29th, he found the nest in an old miner's tunnel, 85 feet from the entrance. He says: "It was built up on the floor of the tunnel, and looked very much like a comfortable old hen's nest; but instead of eggs, we found four or five handsome young Rats, gray little fellows with fine, fluffy soft fur, large ears, and bright, black eyes.

"While we were admiring this litter, much to our surprise, the intrepid mother Rat came to the nest; and, in the full glare of the mine lamps, settled herself in a comfortable position. It looked as if the young Rats had just ordered their breakast, and she would not postpone it a minute on our account. But we were mistaken in her intentions; for, after a few minutes, she rose from the nest with a furry burden clinging to her tits. Besides holding on with their teeth, the young Rats had firm hold on the mother Woodrat's bushy tail. Toe-holds, tail-holds, or possibly a combination of both secured them to her. The old Rat made directly for the mine shaft, descending gracefully and proudly, 'with her tail between her legs,' into the inky darkness

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[27] Dusky-foot, p. 5.

[28] As above, p. 6.

[29] As above.

where there was nothing but the rough rock wall to cling to, in the descent of 50 feet down to the lower tunnel."[30]

A great many of the rodents transport their young in this way, at least occasionally; but the Packrat has carried the method to something like perfection—as, indeed, the species has developed everything that relates to transportation, passenger or freight.

A Long Food List

He would not be worthy of his family name if he did not eat all things eatable—fruit or grain, vegetable or animal, man-made or native-grown—that he can secure when hungry. Nevertheless, in this vast acceptability, his emphasis is on nuts, berries, and grain.

As evidence of his food in times of stress, we have some observations by Lee R. Dice, on the species in eastern Oregon. He says: "During late June, 1922, an expedition from the Michigan Museum of Zoology camped for several days in this orchard. We noted that the bark of many of the trees had been gnawed by some small animal, the tooth marks being too small for those of a Porcupine. One night, about midnight, I saw some animal gnawing on the limb of an apple tree over my head, and the next day, I set a steel trap at the base of the tree; during the night, this trap caught an adult female Wood-rat (*Neotoma cinera occidentalis*). There can be no doubt that this species is responsible for the damage done to the trees."[31]

Parks gives many observations to show that in California, certain fungi, especially of the genus *Hysterangium*, are favourite foods of *fuscipes*. Doubtless, *cinerea* will be found possessed of similar tastes. "The Wood-rat," he says, "is the mushroom-hunter par excellence."[32] He found that where the above-named fungus were abundant, Wood-rats likewise were numerous; and says that that fungus "is, in appearance, like a little white puffball with a tough, rubbery gleba, usually of a green colour. Its predominant character is its exceedingly vile odour, when mature. It is almost impossible to carry the plants in a collection, so offensive is this odour. Its habitat is among the leaves, or slightly buried in the ground, where it is easily accessible to the rodents. Where it is to be found, the Rats will pass by all other fungi to get it. I have seen fragments of the white peridium scattered over considerable areas of the forest; and excavations are to be found everywhere. The peri-

[30] Can. Field Nat., May, 1922, p. 88.

[31] Journ. Mamm., Nov., 1925, p. 282.

[32] Santa Cruz, p. 250.

dium seems to be rejected for the tough gristly interior portion. It is frequently to be noticed that many young plants are left, the Rats taking only those which have fully matured."[33]

Storage Habit

The Packrat lives in a land of hard winters with deep snow, yet does not hibernate. Therefore, he must store up food in harvest time. That he does so, is attested by many observers.

Thus, Nelson says: "Wood-rats, especially in Northern localities, gather stores of pinyon or other nuts, potatoes, corn, and any other non-perishable food available; to meet the season of storms and scarcity; concealing these supplies in cavities in the nests, either above or below the ground."[34]

One of the strangest detailed testimonies is from A. W. Anthony, who says: "In December, 1916, while engaged in securing data for a report on some mineral lands near Magdalena, N. M., a small mining town 20 miles west of Socorro, I was surprised at the large shipments of pine nuts that were being sent to market from that station. A few miles west of Magdalena, there is a considerable growth of pinyon trees, that might furnish a large harvest of nuts; but, knowing the natural distaste on the part of the Mexican inhabitants for manual labour between meals, I was puzzled to account for the wagon-loads that they were daily bringing to market.

"I was told that 8 carloads had been sent to the eastern dealers, at that date; and as many more were expected before the end of the season.

"Upon inquiring of the Mexicans, as well as the American merchants, I learned that the nuts were all secured from the storehouses of the Wood-rat. Armed with an iron hook, about 3 feet in length, for removing the top of the nest, the Mexican nut-hunter seeks the cactus thickets in the neighbourhood of the pines. The nests and storehouses of the Wood-rat are usually placed in the shelter of the chollo cactus, if any are about, and thus protected, are comparatively safe. The dome-shaped collection of sticks, dead cactus, and in fact everything movable within a hundred feet of the nest, is the retaining wall of a store of nuts, of from a quart to five gallons; the man securing in a few moments what he might pick up from the ground, under the pines, in a day's work. I was told that this store would be renewed within a week; and the same Rat pay rent perhaps as many as five or six times during the fall and winter.

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[33] Santa Cruz, p. 252.

[34] W. A. N. A., p. 517.

"I think that the storehouses are always separate from the nests; and at times, are at quite a distance from nests that are occupied."[35]

A somewhat conflicting view is taken by Parks—at least as regards *fuscipes* in California. Discussing the quantities of food found in a nest, he says: "No permanent food supply seems to be laid up regularly for winter use, as is the case with the Northern rodents. The climate is such that there is a constant supply of food of some kind available the year round. The conclusion is that, when food is found in the nest, it is there for the feeding of the young."[36]

In one nursery nest, he "counted over 500 acorns, without taking more than half of them."[37] In another, he found "great numbers of madrone berries, which had been cut from the trees in clusters, and taken to the nests as needed."[38]

This different habit discovered in California, may be due to the difference in species; but more likely, to different climatic conditions.

His Museum

The most amazing propensity of the Packrat is the one from which he gets his name—the mania for gathering in one place a collection of bright, curious, unusual, or interesting (but quite uneatable) things—a museum of his own. It is akin to his food-storage and to his nest-building impulses. Yet it has developed into something quite different from either.

There is scarcely any object unusual and small enough, that the Packrat will not add to his museum, especially if it glitter, or, in some way, catch the eye. I have seen nesting mounds made of cactus spines and cow-dung; but the museum exhibit on the top comprised shells, pebbles, pine cones, twigs, sticks, cactus prickles, seed pods, bits of tin and china, old cartridges, broken buckles, rags, leather scraps, feathers, skulls of small animals. I have heard of every movable kind of personal property in the collection, including a bottle of oil, a pair of spectacles, a set of false teeth, a box of matches, and a stick of dynamite.

E. W. Nelson says: "At one cabin in the mountains of New Mexico where I lived one summer, several Mountain Rats made free of the place; and at night, persistently tried to add our shoes to their nest under the floor. An hour or so after retiring, we would hear our shoes scrape slowly across the floor; and in the morning, they would be found stuck toe-down in the

[35] Journ. Mamm., May, 1920, pp. 140–41.

[36] Santa Cruz, p. 249.

[37] As above, p. 249.

[38] As above, p. 248.

broad crack where the floor ended near the wall. In the Wood-rat country, when small articles are missed from camp, it is always worth the trouble to investigate the nearest Rats' nests."[39]

Merritt Cary found the Pack-rats a veritable nuisance. They were continually stealing his traps. He says: "So commonly was this done, that, on missing a trap, Donald and I would go to the nearest Rat house, where we were almost certain to find it."[40]

"I have a record of a nest," says Parks, "built at a considerable height in a pine tree, that contained the bright inner lid of a lard pail, stolen from the camp table, an old-fashioned perfume bottle with a little mirror on one side, and many musty prunes and crackers. The perfume bottle contained gun oil, and was rescued without the contents having been spilled."[41]

"At the cabin of a friend," he continues, "the food supplies were regularly raided, and the salt and soap seemed to be favourite articles. One spring my friend missed some silk socks and a bright necktie. In the fall, we found both in remnants, together with some soap, in a nest a quarter of a mile away.

"The Rats seemed to develop a streak of mischief with a bit of humour and persistence in it. Every night, the woodbox in the cook shack was a centre of attention. This building being more or less open, the Rats had easy access at night. In the morning, the wood was to be found on the floor, the pieces being laid out in rows, and placed neatly end to end. This was repeated many times."[42]

That the instinct is not lacking in the Eastern Woodrat [*pennsylvanica*] is evidenced by the following from the pen of Earl L. Poole, of Reading, Pa. He says: "On Sept. 2, 1921, I captured two adult specimens of this interesting Rat on top of The Pinnacle, a spur of the Blue Mountains, in northern Berks Co., Pa. . . . Dr. J. J. Shelly of Stony Run and I spent the night on the mountain, after having previously set out several traps.

"From the commotion which these animals made toward midnight, I felt certain that there must be a very large colony about; and in the morning, we were astonished to find that everything that we had left loose, had been carried away by the Rats, even down to our lunch and a pair of spectacles, which had been deposited on a flat rock within a couple of feet of where we slept."[43]

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[39] W. A. N. A., p. 517.

[40] Quoted by Bailey, Texas, p. 113.

[41] Santa Cruz, p. 242.

[42] As above, p. 248.

[43] Journ. Mamm., May, 1923, p. 125.

As Trader

The second baffling instinct—the one for which he gets his name of "Trade-rat"—is even harder to explain than the foregoing—that is, his habit of exchange. When he pilfers some useless bauble from the ranchman's house, he commonly leaves in its place a product of his own domain. For example, he may carry off the silver spoons, and fill the empty place with toadstools; lug off the kitchen clock, and on its shelf set up a Rabbit's skull; empty the box of chocolates, and fill it up again with cow-chips.

In further detail, Parks says: "They have a fondness for dried prunes, crackers, bits of glass, bright metal, and sometimes, pieces of brightly coloured cloth; and will carry such things to the nests for storage. In exchange, they leave a chip, a small stone, or anything that may happen to be handy: and such things were frequently left in place of my bread and potatoes."[44]

I knew of an old-timer who went in haste to the drawer where he kept his revolver cartridges. He grabbed a handful, and then found he had nothing but Elk pellets. The Trade-rats had taken the ammunition, and left these in its place.

One of the best gold-mines in Saline County, Ariz., is said to have been discovered in the following way. A Packrat stole a number of trifles from the miner's cabin; but, in their place, left some nuggets and valuable bits of gold quartz. The miner watched the Rat, located the vein, and made his fortune.

It is not necessary to postulate a theory of commercial honesty on the part of the Rat or even a sense of humour, when we seek for explanation of this give-and-take. So far as I can analyse it, the Rat, impelled by the museum avarice, carries off a spoon to his own particular cabinet. He drops the spoon. The mania to carry is still on him; so he seizes any of the near-by objects—cones, cow-dung, or pebble—and carries it back on the return trip. Here the superior allurement of the spoons causes him to drop the cow-chip, and take another spoon. In this way, apparently, the trade is effected.

Who Will Tell Us?

It would shed valuable light if some trained naturalist would, by experiments, answer such questions as these: Is the museum instinct an outcome of nest-building, of food habit, or what? Is the museum ever remote from the nest? Is the instinct found in both sexes? (By all the rules, it should

[44] Santa Cruz, p. 242.

be strongest in the old males.) Do two Rats ever combine their efforts in one museum? Do individuals specialize on certain lines of curios? Do they show colour preferences? Is the creature ever seen gloating over his collection, or arranging it, or spreading it out in the sun? Do they steal from each other's museums? If so, do they leave an exchange value? Have they any social life? If so, does the museum figure in it?

There cannot be the least doubt that, in its last analysis, the Packrat's impulse to gather treasures, is precisely that of any other curio collector—the pleasure he gets in seeing, handling, and owning strange and attractive things. We must admit that, however crude, it is an æsthetic instinct, like that of the Australian bower-bird, or of the human collector, who devote their best energies to amassing and arranging beautiful and curious objects at a special and prepared place, a place that has no relation to their ordinary functions of life.

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LIFE LXXXVII—MOUNTAIN BEAVER

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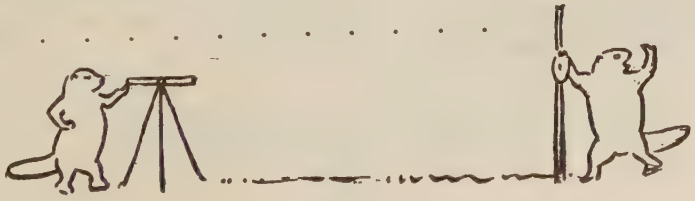

Mountain Beaver, Sewellel, Blue Muskrat, Mountain Boomer, Ground Beaver, Underground Beaver, Muskrat Beaver, Showt'l, Kick-willy, Giant Mole, Ou-ka-la, Haplodon, Aplodon, or Chehalis

Aplodontia rufa (Rafinesque)

(Gr. *aploos*, simple; *odous*, tooth, from the apparently simple structure of the molars; L. *rufa*, reddish)

Anisonyx (?) *rufa* RAFINESQUE, 1817, Amer. Monthly Mag., II, p. 45, Nov.
Aplodontia rufa MERRIAM, 1886, Ann. N. Y. Acad. Sci., III, p. 316, May.

Type Locality—Near Columbia River, Ore., probably in the Cascade Mts. Taylor regards as typical, specimens from the western slope of Mt. Hood.

FRENCH, *L'Aplodontia brune.*
YAKIMA, *Squallah* (Cooper).
CHINOOK. "The Chinook name for the animal itself is *O-gwool-lal. She-wal-lal* (Sewellel, corrupt) is their name for the robe made of its skins." (J. G. Cooper.) *Showhurll* (Suckley, p. 100). *Showt'l* is another form of the same; but W. P. Taylor gives a dozen by which the local and small groups of Indians know this strange creature.

The name *Mountain Beaver* has some warrant in the creature's relationships, as we shall see, and is further justified by the largest usage.

The genus *Aplodontia* (Richardson, 1829) comprises rodents the size of a small Woodchuck or a Rabbit, with short legs, thick bodies, short ears of almost human shape, and a tail so short that it does not stick out beyond the fur. The genus is characterized by having 5 toes on each foot; but the inmost toe on the front foot, that is, the thumb, is a mere stump which, however, acts as a pusher. The other fingers work against it; and it can take a good grip of food that the creature is eating, of stones that it would dig out, or the limbs of trees when it climbs. The group has long, digging claws, 6 mammæ, and teeth as follows:

$$\text{Inc. } \frac{1-1}{1-1}; \text{ prem. } \frac{2-2}{1-1}; \text{ mol. } \frac{3-3}{3-3} = 22$$

Thus, the teeth are exactly as in *Marmota* and others of the Squirrel Family, to which it is distantly related; having affinities, indeed, with both Marmot and Beaver.

In addition to the generic characters, the Mountain Beaver has the following:

Size. Length, 13⅜ in. (336 mm.); tail, about ½ in. (12 mm.); hind foot, 2¼ in. (56 mm.).

Weight. 4 lbs.[1]

Colour. All above, in all seasons, light ochraceous-buff, sometimes shaded into light buff on the fore parts; sprinkled over everywhere with blackish hairs; all below, grayish, with a faint wash of brown; a white spot at the base of the ear.

Sexes alike, but adult females often have prominent dark spots about the mammæ. The young are like the adults, or a little darker.

When seen close at hand, the Mountain Beaver looks like a dark Rabbit without ears, or a small blackish Woodchuck without a tail.

In some of its habits, as well as appearance, this animal greatly resembles a large Pocket-gopher (*Thomomys*). In each we see the result of perfect adaptation of the creature to underground life, where it must dig a new tunnel each time it would explore in a new direction.

Musk. The freshly killed animal gives off a penetrating musky odour that reminds one of the Muskrat. This musk is so strong that it persists on skins that are several months old.

Tear Fluid. The tear fluid of the eyes is remarkably thick and sticky, and is opaquely whitish; it looks like a white film across the eye. Doubtless, this fluid is specialized to be more effective against the loose earth of its underground home.

Testes. According to C. A. Hubbard,[2] the testes are normally in the abdominal cavity; but, in the mating season, are lowered outside or withdrawn at will.

Whiskers. The remarkably developed whisker bristles are doubtless significant, but no one yet has written their story.

Races

Following Walter P. Taylor's admirable revision of the genus, these races are recognized:

rufa Rafinesque, the typical form. T. l., Marmot, Clackamas Co., Ore.

[1] Merriam, New Species, p. 314.

[2] Some data, p. 17.

californica Peters, like *rufa*, but grayer, and with different skull. T. l., Blue Canyon, Sierra Nevada.

rainieri Merriam, like *rufa*, but grayer, with less brown beneath, and different cranial characters. T. l., Mt. Rainier, Wash.

olympica Merriam, like *rufa* externally, but different in skull characters. T. l., Quinault Lake, Chehalis Co., Wash.

columbiana Taylor, like *olympica*, but larger. T. l., Hope, B. C.

pacifica Merriam, small and very dark. T. l., Newport, Yaquina Bay, Ore.

phaea Merriam, a small brown race; smallest of the races, and palest of the coast forms. T. l., Pt. Reyes, Marin Co., Calif.

nigra Taylor, very dark, shiny black, faintly peppered above. T. l., Pt. Arena, Mendocino Co., Calif.

humboldtiana Taylor, like *pacifica*, but larger and paler. T. l., Carlotta, Humboldt Co., Calif.

It will be noted that these are in two groups—first, a group of large gray forms in the high mountains; and second, of small dark forms along the Coast Range.

History

Like the Mule-deer, the White Goat, and several other species, the Mountain Beaver was introduced to the world of letters by Lewis and Clark.

In Dec., 1805, these leaders of the famous expedition reached the West Coast, and established winter quarters at Fort Clatsop (now Astoria, Wash.). On Friday, 13 Dec., notwithstanding its combination of ill omens, this lucky entry was made in Clark's record:

"The *Clatsops* leave us to-day after a breakfast of Elk, which they appeared to be very fond of. Before they left us, they Sold me two robes of the skins of a Small animal about the size of a Cat, and to Captain Lewis 2 Cat or Loucirva skins, for the purpose of makeing a Coat."[3]

The Indians, when questioned about the two strange skins, said they were "*She-wal-lal*," that is, used to make a "*robe*." But knowledge of each other's language was rudimentary; and Clark, in perfect good faith, wrote "Sewellel," as the Indian name of the animal. But this was Friday, the 13th. The name was most unfortunate. It was not descriptive; it was not easy to say or remember; it was not composed of familiar elements; the accent was wrongly placed; in short, it was not English, and couldn't be Englished. Therefore, it is disappearing; even now it has nothing but a book existence.

[3] Exped., Paul Allen edition, Phila., 1814, II, pp. 176–77.

However, this was the first time of record when a white-man set eyes on the skin of this curious creature. This was its introduction to history, and led ultimately to systematic consideration.

In 1817, the erratic, enthusiastic, and voluminous Rafinesque plunged in on the strength of the Lewis and Clark account, and named the creature *Anisonyx rufa*. Here is the whole of his account:

"*Anisonyx* (?) *rufa* Raf. Fur long, silky, entirely reddish brown, ears short, pointed with short hair.—Obs. This animal called Sewellel by Capt. Lewis and Clark, is of a doubtful genus, since they only saw the fur of it; it burrows, and runs on trees like the Ground-squirrels; length, 18 inches, found in neighbourhood of the Columbia River."[4]

The generic name *Anisonyx* was rejected because it was apparently based on the Ground-squirrel of which the earliest name is *Citellus*.

In 1829, Dr. John Richardson secured a skin—probably the first known to a scientific naturalist—through the fur-traders of the Hudson's Bay Co., and established the genus *Aplodontia*, of which it is the type and sole member.

In 1860, George Suckley offered a few notes on its habits.[5]

In 1866, J. K. Lord contributed a brief life-history.[6] J. M. Murphy (1876), F. S. Matteson (1877), S. K. Lum (1878), A. Brooks (1899), and J. Muir (1909), all helped our knowledge. But the really illuminating accounts were H. E. Anthony's "Habits of Aplodontia" (1916); W. P. Taylor's "Revision" (1918); and latest, the admirable monograph by Charles L. Camp (1918), which, with Anthony's paper, is the basis of the present life-history.

Range and Haunts

Map II (p. 85) shows the main outlines of its range, doubtless larger and less broken than here implied. It is a creature of dense forests, of heavy rainfall, and temperate climate; is absolutely confined to our West Coast; and has no generic brethren, so far as known, living anywhere else in the world. It has the smallest range of any species treated in this work, with the exception of the Round-tailed Muskrat.

Within the broad outline of the great range strung north and south on the map, among the noblest forests of America, are the chosen haunts of this odd creature. Its ideal homeland is pretty well known, and partly understood. The animal is happy only in deep alluvial soil where it can burrow

[4] Amer. Monthly Mag. & Crit. Rev., 2, p. 45.

[5] U. S. Pac. R. R., p. 100.

[6] Naturalist, Vancouver Id., I, Chap. 13.

freely; it must be near running water—indeed, it prefers a soil oozing with water—is it not a Muskrat-Beaver? It must be in a place that abounds in plant growth—root, shoot, and overlimbs. Damp, dense, heavily forested, sunless woods, along low, slow, muck-banked streams, are much to its taste. It is like a Muskrat that has taken to the haunts of the Beaver, and adopted the habits of a Mole.

Although boggy slopes and the banks of streams are the favourite situations, tunnellings in dry wooded and brushy places at a distance from water are sometimes inhabited in the wet season, and abandoned in the dry —an arrangement that most of us would reverse. If the food supply continue, such burrows may be used the year round.

Along the coast of California, the Mountain Beavers invariably choose for their colony a spot within dense thickets of ferns, thimbleberry, and other low plants in wet, or at least damp soil. So well concealed beneath tangled shrubbery are the unplugged burrows, that commonly the presence of the animals is unsuspected even by the settlers on the same land.

In the interior mountains, the larger or upland races seem to select a slightly different home range. They are sometimes in flats, but much more often along canyons and mountain slopes, among willow, alder, aspen, or other thickets, or even in the heavy coniferous forest.

Townsend says that in northern California, "these burrows were in a wild gorge, deep and narrow, down which the little river dashed with roar and foam. In certain places, where for a short distance, moist, clayey banks took the place of the interminable fallen trunks and boulders, were numerous holes, somewhat resembling those made by Muskrats."[7]

Lum notes that the species of Mountain Beaver along the western base of the Cascade Mountains "usually selects the open glades of the forest, thickly grown up with fern and sallal" for its burrows.[8]

In California, at the southern part of its range, Aplodontia usually prefers a shady, north slope for its burrows; but Brooks states that in British Columbia, the extreme northern range of the genus, this animal prefers a locality "where there is a good thick growth of vegetation on the mountain slopes, especially on those with a south exposure."[9]

"*Aplodontia rufa californica* of the Sierra Nevada, in California, has been found in a variety of situations, at elevations all the way from 5,500 to 10,000 feet."[10]

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[7] Field Notes, p. 175.

[8] Sewellel, p. 10.

[9] Recreation, p. 258.

[10] Camp, Excavations, p. 522.

Finally, Frank Stephens says of the colony he found at Cuddeback, Humboldt Co., Calif., "My previous idea of a burrowing place for Aplodontia is wet or springy land. This is far from that. It is a very steep, south-facing slope almost at the top of a point on a high ridge, and is as dry a place as well could be found. The location is in an open place in a thick forest of redwood, spruce, and fir. It has been burned over three years ago, and there is very little underbrush."[11] This is so variant from the established custom of the species, that it must be listed as an abnormality.

Numbers

The only positive note I find on its numbers is the following: "Specimens were collected in the vicinity of Tillamook, Oregon," says Anthony, "where the animals were found in abundance,"[12] which is not positive at all, but comparative. For the creature may be numerous, if we compare it with Grizzly-bears, and very rare indeed if compared with Meadowmice.

It seems to be found in considerable colonies, when found at all; and yet the trappers say it is easy to clear out these colonies. The observations of Camp, given later, show that in a flourishing colony of 100 x 500 feet, 11 individuals were taken, and seemed to be the total population,—whether parents and young, does not appear. Extensive tracts in the Cascades are honeycombed with its burrows, as fully shown; and yet we do not know how many to the square mile should be considered abundant.

Its skin is not of commercial value, so that we cannot tell how many are marketed each year. Thus, we have no positive data; but it seems clear that it is nowhere abundant, in the sense that Rabbits and Marmots are in places; and we know its range to be very small.

Ou-ka-la Colonies

If the creature is not sociable, why should it live in colonies? We have elsewhere noted the distinction between "sociable" and "gregarious." It seems that this underground Beaver is slightly gregarious in its habits. Thus Nelson writes:

"Veritable colonies inhabit certain areas, and the ground is honeycombed with burrows 6 to 8 inches in diameter, and covered with a network of surface trails. The irregular, branching tunnels are sometimes two or three hundred feet in length; and have, at frequent intervals, side passages through which the earth, mined in extending the burrow, may be ejected in

[11] Ms. 1910, quoted by Camp, Excavations, p. 522.

[12] Habits, p. 53.

small dumps. The tunnels appear, in a large measure, built for the safety of the owner in travelling; since they repeatedly come to the surface at the end of a log, where an open, neatly kept trail extends under its shelter the entire length, the tunnel being resumed at the far end of the log.

"All surface runways connecting tunnel entrances, or leading through the thick surface vegetation, are well kept, and free of all obstructions. The ground in these haunts is commonly so saturated with water that the tunnels form drainage channels down which run little streams."[13]

Anthony, however, with larger opportunities, writes: "The 'colonies' of this animal . . . were found most frequently where vegetation was rankest, and where moist, loose soil made digging easiest. When such a place is encountered, the large holes and piles of earth thrown out from the burrows, are generally numerous, and indicate the presence of several individuals, as well as a marked degree of activity of the individual.

"While it has been asserted that *Aplodontia* is a gregarious animal, and lives in colonies of several individuals, it is, however, more than probable that this number is not very great. A series of runways is inhabited by a single family; and there is no evidence that this animal is as social in its habits as, for example, *Cynomys* or *Microtus*. One might be led to suppose many individuals were present because of the amount of earth thrown out, and the numerous runways; but this is easily accounted for by the activity of the Showt'l.

"Traps set in the runways were almost always successful the first night —one and possibly two animals being caught. Thereafter, traps set in the same immediate vicinity yielded nothing for several days at a stretch, probably until some neighbours wandered over from near-by runways. This lack of success in trapping after the first 2 or 3 animals were caught, was not due to caution on the part of the animal, for *Aplodontia* exhibits no inherent cunning, and is easily caught in exposed traps. Furthermore, no fresh dirt was thrown out after the first animals were caught, nor were any of the cut leaves and green twigs, so commonly lying about the burrows, to be seen. All the evidence pointed unmistakably to a depletion of the colony; after 2 or 3 had been caught, the burrows had a lifeless appearance, and débris that had fallen into the runways was undisturbed. By shifting the traps about, it was ascertained that the area dominated by these few individuals was rather extensive; for not until traps had been shifted some distance, could another set of animals be taken."[14]

Another interesting observation by the same naturalist tends to prove

[13] W. A. N. A., p. 532.

[14] Habits, p. 54.

that an abundant food supply, rather than love of good company, is the cause of many Ground Beavers assembling in a given place.

"Much the largest and most flourishing colony," he says, "was found in the orchard of a deserted farm. Here under 'evergreen' blackberry bushes, large quantities of earth were thrown out every night, and great activity was evident. It is not improbable that the tall, rank grass, and such low fleshy-leaved plants as the dandelion, were the important food items here; for cut grass stems were seen about the burrows, and the absence of any other suitable food went to support this supposition."[15]

Burrows and Tunnels

Wherever the Mountain Beaver establishes itself, it digs a complicated network of tunnels, from a few inches to two feet below the surface of the ground. These tunnels are extensive in proportion to the number of the animals in the colony (Plate LXIX, p. 546), which probably means that each pair has a main burrow which ramifies and joins on to the home run of the next digger.

Each burrow system has many openings to the surface. As with most tunnelling animals, some of these openings are for entries, some for dumps, and some with small concealed openings, for ventilators. Furthermore, it seems that some of them are for drains.

C. A. Hubbard describes burrows of two types—the home or individual burrow, and the communal burrow.[16]

The home burrow is short and simple. It is situated in a bank whenever possible. It contains the nest that is the family home. It is private property, and is held jealously against all intruders.

The communal burrow is very large, long, and complex. Its interior shows that it has been used by the colony for years. "The sides are worn smooth," he says, "and are packed tightly by the brushing past of generations of the animals. . . . [The] floor is packed so hard by the patting of myriads of feet, that it can be taken up as if it were asphalt.

"These communal ways connect each individual system. They lead to water, to favourite feeding grounds, and form a means of communication during the breeding season."[17] They are, indeed, the streets of the town on to which open the hallways of the home burrows.

How large are these towns? We may form some idea from the following:

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[15] Habits, p. 58.

[16] Some data, p. 14.

[17] As above, p. 15.

Camp says: "Near Point Reyes, in the gulches 5 miles west of Inverness, Marin County, Calif., trapping was carried on in 1913 in 2 colonies of *Aplodontia*. . . . The burrows extended along the side of a low, north-facing bluff, among bare hills for 2 miles or more.

"One section of this colony, in a rectangular area about 500 x 100 feet, contained at least 100 burrow entrances. Here 169 'trap-nights' (one trap out one night equals one trap-night) in 36 burrow entrances, produced 11 specimens. No individuals were secured in the last 46 trap-nights—an indication, perhaps, that the catch approximated the total population of that part of the colony: 92 trap-nights in another limited part of the above colony, produced 6 specimens."[18]

Similar burrows were examined at Point Arena, Mendocino Co., Calif. The form of this region "lives on north-facing gulch sides in a small area (about 24 square miles) along the central Mendocino County coast. The colonies now known, extend from the town of Point Arena to Alder Creek, $7\frac{1}{2}$ miles north. In the case of the race *phaea*, colonies occur in a part of the Point Reyes Peninsula and country adjacent, in Marin County, Calif., an area of not more than 110 square miles in all."[19]

Such complex and extensive subterranean villages remind one of the Catacombs of Rome during times of persecution, or of the residential salt-mines of Galicia to-day.

These far-reaching underworlds of the Mountain Beaver, however, are evidence of unusually congenial conditions. It seems that localities of skimpy food supply result in a much sparser population.

"In the Yosemite National Park," says Camp, "extensive thickets of the preferred food plants are scarce; and here the Mountain Beaver must, as a rule, be content with limited tunnel systems through the narrow willow-fringes along the streams.

"At Chinquapin, 6,200 feet altitude, in the Park, a tunnel [Plate LXIX, Fig. 3] of *Aplodontia rufa californica* was excavated for a distance of 12 yards along the steep bank of a stream, without the discovery of a single side branch of importance. Only 2 individuals, male and female, were captured in this tunnel. The burrows in the colony at Chinquapin were far scattered along-stream, owing to the narrowness of the area available to the animals. At many other localities in the Park, similar conditions prevailed. Small colonies with more complicated systems of runways are sometimes established where conditions will allow, as, for example, in willow thickets

[18] Excavations, p. 520.

[19] As above, pp. 521–22.

PLATE LXVI.—MOUNTAIN BEAVER IN THE ELK-BRAKE

Photograph by H. E. Anthony

bordering meadows and, high up in the mountains, in Labrador tea and willows along creeks and about springs.

. . . . . .

"The burrows of *Aplodontia rufa rufa* of the Trinity and Siskiyou mountains, to judge from the descriptions given by Kellogg (1916, pp. 369–72) and Alexander (Ms., 1911), appear to be similar to the more simple type of tunnel system of *A. r. californica*. Even in one exceptional case where the ground was found to be 'literally honeycombed' by burrows and runways, a 'main tunnel' could be distinguished. As with *californica*, never more than one pair of animals was secured from a single set of runways."[20]

Like the Pocket-gophers, the Mountain Beaver is often active under the snow; and the soft earth is pushed up into the snow tunnel, filling it for some distance, so that when the snow melts away, the curious earth plug, the cast of the snow tunnel, is left exactly as noted in the Pocket-gopher. (See Plate XLVII, p. 411).

Water Control

One of the most Beaver-like and interesting exploits of this animal is the management of underground streams. Whether it is done for drainage, or for a drinking supply in a safe place, or by accident, it seems clear that the Showt'l commonly controls the water supply that belongs to his home range. He has the true instinct of the Western homesteader; the moment he has selected his location, he sets about coralling and controlling the water.

Lum says of those burrows he examined on the Cascade Mountains, "In many places, I found water coursing its way through the passages."[21]

Stephens says: "In a few cases, spring brooks had broken into the upper entrance, and ran in the burrows instead of in their natural channels. In one case, a brook was diverted from its own channel to . . . one several yards away."[22]

"Arrangements are always made for the proper drainage of the burrows," says Camp, "and in wet hillsides water often runs continuously from the lower tunnels. In some places, the courses of streams are diverted, though perhaps accidentally."[23]

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[20] Excavations, pp. 524–25.

[21] Sewellel, p. 10.

[22] Calif. Mamm., 1906, p. 94.

[23] Excavations, p. 532.

"In almost every colony, tunnels were found containing running water. At one place, the entire flow of a small stream was taken care of for some distance below ground."[24]

John Muir seems to have been singularly fortunate in discovering a new irrigation ditch at the triumphant moment when first the water was turned on. He relates that, in the Yosemite Park, the Mountain Beaver "digs canals, and controls the flow of small streams under the sod"; "and it is startling," he says, "when one is camped on the edge of a sloping meadow near the homes of these industrious mountaineers, to be awakened in the still night by the sound of water rushing and gurgling under one's head in a newly formed canal."[25]

Drink

Although not aquatic, in the sense that holds with Beaver and Muskrat, the Mountain Beaver is not happy away from the water. It drinks much and often. Brooks says: "Where numerous, its burrows extend in all directions underground, one or two well-travelled highways always leading to the nearest water."[26] And Anthony adds that his captive drank large amounts of water when it was given him, not lapping daintily like a Cat, but dipping his nose into the water to drink copiously as though he enjoyed it.[27]

Food

With a vast number of careful observations before me, I hesitate to enumerate the food plants of this animal. It would be little more than a barren, botanical list, covering two pages, and including really every green, succulent, and semi-succulent plant, shrub and bark that is found in the rich, wet grounds where gather the Mountain Beavers to burrow and seek their daily provender. The only plants native to their range and not on that list, are probably the actually poisonous, or wholly woody kinds.

They have their favourites, of course. On the Coast Range, they "are predominantly fern- and root-eaters."[28]

In the north, its "favourite food plant is the 'Scotch Cap' *Rubus nutkanus*."[29]

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[24] Excavations, p. 525.

[25] Our National Parks, 1909, p. 201.

[26] Recreation, p. 258.

[27] Habits, p. 56.

[28] Camp, Excavations, p. 525.

[29] Brooks, Recreation, pp. 258–59.

In Oregon, according to Anthony, its choice is thimbleberry, elkbrake and sword-fern.[30]

In captivity, it shows its adaptability by eating celery, carrots, turnips, potatoes, cabbage, lettuce, apples, and other fruit.[31] Why not? I should like to ask, if in its native village, it is taught to look on coarse-grained elkbrake and fibrous sword-fern as sweet and luscious dainties.

"Since its country has become increasingly occupied by farmers, it has developed a fondness for cultivated crops, that, in many places, is rendering it a pest. It appears to have a special taste for cabbage, potato, and onion tops, and other garden produce."[32]

Feeding Habits

The Mountain Beaver, according to Camp, "is rarely seen in the daytime, but comes forth early in the evening in search of food, and doubtless remains active throughout the night. [B. J.] Bretherton[33] mentions that he has trapped a large number without ever having seen one abroad in daylight. Our own observations, as well as those of others, confirm him. An individual . . . that the author kept captive, built itself a nest where it remained passive in a sitting posture throughout the day."[34]

"The manner of feeding has been observed in the captive animal, and partly determined from the evidence of cuttings. The rodent usually sits back upon its short tail, with the back curved, the hind feet extending out in front, soles forward, and the fore paws grasping the stem, root or leaf. The short first finger is used like a human thumb, and the large callosities on the palms aid in holding an object so firmly that it can be retained easily in one hand. Stephens (1906, p. 95) says that the hind feet as well as the fore feet are used in grasping. Plants are harvested in sections from 2 to 6 inches in length, so that they can be dragged into the burrows. Tough, woody twigs and stems are chewed through from one side only, not in the manner in which Beavers attack large trees. If the plant is a soft annual, the whole stem is rapidly nibbled; if a perennial, the bark is chewed off in the manner of a Beaver or Porcupine, and the wood discarded."[35]

Anthony, describing the food habits of one which he held captive, says: "So rapidly did he become tame that, by nightfall of the first day, he

[30] Habits, p. 57.

[31] Camp, Excavations, p. 527.

[32] Nelson, W. A. N. A., p. 532.

[33] Some Oregon Mammals, Oregon Nat., II, 1895, p. 124.

[34] Excavations, p. 528.

[35] As above, pp. 529–30.

took young fern shoots from my hand, and ate them while seated upon the window sill of my room, completely oblivious of my presence. His appetite was good, and he ate a number of fern tips, generally selecting the youngest and softest from the handful offered him. The elk-brake, *Pteris aquilina*, that seems to be one of his main articles of diet, has many branching stems that bear the green foliage. The Showt'l clipped off an inch or two of the terminal stems, a single snip of the sharp incisors generally severing the small stem. Then holding this stem in his fore paws, the animal passed the tender fronds back between the molars; and with a rather hurried crunching, munched them down, mastication, though rapid, seeming to be quite thorough and audible as well. The lateral stems were clipped off close to the main stem, and after the greenest of the terminal stems had been eaten, the animal, after sniffing over the rest of that particular fern, passed on to a fresh one, some preference being given to the more succulent portions. If a stem that was fairly hard and brown was trimmed off, after the fronds had been devoured, it was discarded."[36]

"This rodent is slow and cumbersome in gait, and seldom ventures far from its burrow. Tunnels are dug directly into suitable clumps of vegetation where the animals wish to forage, and from the burrow entrances issue short trails or runways along which the animal transports cut stems and leaves to the mouths of its burrow system. Occasional sections of cut material are dropped along these pathways, thus distinguishing them from the runways made by Rabbits and Ground-squirrels. Remains of fresh leaves and twigs pulled just within the burrow entrances, lead one to believe that the timid Mountain Beaver does much of its feeding in the comparative security of its burrow."[37]

Haymaking

One of the most picturesque habits ascribed to this somewhat unpicturesque animal, is haymaking. Every recent observer has noted it, and offered some enlightening comments which may be summed up thus:

"Gibbs (in Suckley, 1860, p. 100) was the first to note a peculiar haymaking habit among the Mountain Beavers he found living at the top of Yakima Pass, Washington. 'Near their abodes,' he says, 'were small bundles of some herb or plant cut with nicety, and laid out on logs to dry or wilt'; and Lyon ([Mamm. Mt. Rainier] 1907, p. 91) and Bretherton (1895, p. 124) confirm this. Townsend (1887, pp. 174–175) thought he recognized the hay-

[36] Habits, p. 56.

[37] Excavations, pp. 528–29.

making instinct among the *Aplodontia* he observed on the North Fork of the Feather River in California. Elliot ([Mamm. Olympic Mts.] 1899, p. 252) makes particular notice of the haymaking habit, and adds that the cured stems of the lily, which he saw *Aplodontia rufa olympica* using, may be employed either for food or as bedding in the nests.

"Stephens ([Calif. Mamm.], 1906, p. 95) writes: 'I saw bunches of plants laid up on low bushes to dry, commonly over entrances to burrows, most of these not being much dried, as if they had carried them in as soon as they were well wilted'—this in regard to *Aplodontia rufa californica*, on the headwaters of the Carson River in Alpine Co., Calif. Miss Kellogg ([Mamm. & Birds, Calif.] 1916, p. 372) speaks of the habit in question as occurring among the colonies of *Aplodontia rufa rufa* discovered on the South Fork of the Salmon River in Siskiyou Co., Calif. She says: 'We found the Mountain Beavers making what we call hay—large bunches of green plants of various kinds cut up and spread out as if to dry and to be used later.'"[38]

"The Mountain Beaver has the interesting habit of gathering stores of green plant food, much like that of the Cony on the mountain tops, but appears to be more methodical in its ways, gathering the stems of such plants as grasses, ferns, and lupins, as well as twigs of various bushes, and carrying them in bundles as large as can be held in the mouth, the butts of the stems neatly laid together. These little bundles of 'hay' are placed side by side about the entrances of the burrows, with the butts all parallel on sticks or other support, to keep them as clear as possible from the ground. They are left thus for a day or more to cure before being carried into the subterranean storerooms."[39]

More than 30 species of native plants have been found among the hay piles at the mouths of burrows.[40]

Now to smear this interesting picture, comes Chas. L. Camp, who, summing up these haymaking pursuits, says:

"From observations of the nests and of feeding habits, my own conclusion is that the animal does not eat dried food, but uses its hay for nest-building material."[41]

The answer is: This may be true in summer, when succulent food abounds, and when Camp observed it; but it is well known that the nesting instinct of rodents is close kin to the food-storage instinct. Indeed, they grade into each other, and it is morally certain that the Mountain Beaver

[38] Excavations, p. 529.

[39] Nelson, W. A. N. A., p. 533.

[40] As above, p. 532.

[41] Excavations, p. 529.

sleeps on his supplies; that the hay cured and stored in summer is used for food when winter with deep snow shuts off a large proportion of the forage. The Mountain Beaver, like the Calling Hare and many of the Ground-squirrels, will find it much pleasanter to stay at home, and eat dried breakfast foods, rather than venture out into a cold, icy world to seek for forage, most of which at this time, is far inferior to his sun-dried hay.

Storeroom Door

"A singular habit has been noticed in connection with the storage of food. In a burrow excavated at Point Reyes [Plate LXIX, fig. 2] the entrances of two of the food storehouses were found plugged with large pellets of earth, evidently manufactured by the animal for this especial purpose. Those earthen balls were 1 to 2 inches in diameter, and very hard and dry, evidently from having been handled a good deal. It is curious that the outer burrow entrances are not similarly plugged."[42]

Health Department

"The fæces are black, about the shape of those of a Pocket-gopher but larger (in *Aplodontia rufa phaea*, measuring 6 to 7 by 15 to 20 millimetres); the urine is yellow and cloudy. Fæces are rarely seen about the burrows; they are probably deposited in some particular place underground, but I have never succeeded in discovering any in the burrow systems excavated."[43]

"Like burrowing animals generally, the Mountain Beaver is cleanly in its housekeeping; and offal, loose dirt, and débris of all kinds are pushed out by the fore feet and head to the dumps at the less used openings."[44]

Unless the Ground Beaver is different from all other highly specialized miners, he will be found to have somewhere—yes, many wheres—in his tunnels, little dry earth-closets in which proper care is taken of the digestive by-product.

"Arrangements are always made for the proper drainage of the burrows; and in wet hillsides water often runs continuously from the lower tunnels. . . . The Mountain Beaver is not aquatic in any true sense, but is often caught in traps set in the water running through the burrows. The animal is said to dip its fore feet in water and to wash its head."[45]

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[42] Camp, Excavations. Compare *Thomomys*, Life LXXXIII, p. 407, ff.

[43] As above, p. 531.

[44] Nelson, W. A. N. A., p. 532.

[45] Camp, as above, p. 532.

Nest

For long, nothing was known of the breeding habits of this elusive earth-gnome in the darkest forests. The recent careful observations by Camp and Scheffer, however, have shed a good deal of light.

At one point of the tunnel which Camp opened at Point Reyes in 1913, he discovered a nest "half filling a globular chamber about a foot in diameter [Plate LXIX, Fig. 2]. The nest was constructed for the most part of dry sword-fern 'leaves' stripped from the frond stem. It also contained a few large dry leaves of the cow parsnip, a plant nearly everywhere found in the vicinity of the burrows. Some dirt was mixed with the nest, and the whole had been trampled down into a firm mass, flat on top. Adjoining the nest chamber in the excavation mentioned, and opening into it, was a low square 'room' 20 inches in diameter, the floor and sides of which showed signs of continued use by the inhabitants. Pockets near by contained stored roots, stems and leaves carefully blocked in by artificial earth pellets."[46]

"Nest chambers discovered by T. H. Scheffer in the Olympic Mountains were located in tunnels 2 feet underground. They were oval in form, and one measured 18 inches in horizontal diameter and 17 in height. Here 3 storage chambers opened directly from the nest chamber, one of which contained 2 quarts or more of sections of fern roots, which had been kept so long they were spoiled; and another was partly filled with freshly cut leaves of nettles and twigs of cedar and fir. At the far end, an opening dropped 6 inches into a small drainage basin partly filled with water, out of which led 2 passages. The roofs of the chambers were lined with a thin layer of clay, which appeared to have been packed in place by the owner."[47]

Mating and Young

Almost nothing is known about the mating and breeding habits of this furtive creature. Trappers generally testify that a pair are found in each labyrinth, and when these are caught, all signs of occupancy in that place cease for a time.

On Mt. Shasta, Osgood concluded, after much observation, that "only one individual or, at most, a pair, lived in one place; though several may be distributed among the branches of a stream."[48]

C. A. Hubbard's observations on the breeding may be thus summarized: The mating season is February and March. The species may be promiscuous,

[46] Camp, Excavations, p. 521.

[47] Nelson, W. A. N. A., p. 532.

[48] Merriam, Shasta, p. 93.

but there is some evidence to show that they pair. Gestation probably lasts 6 or 8 weeks.

In 1918, the first pregnant female was taken Feb. 26th; she carried two small embryos, about the size of buckshot.

The young are born about April 15th. They are usually 2, but, in some cases, 3 or 4 in number. The male does not help in caring for them.[49]

Scheffer says of the chamber already described: "In the upper and drier part of the nest, which was made of dried fronds of ferns, grasses, and small twigs, were found 3 young less than a week old, with coats of fine fur, but with eyes still closed."[50]

During May, many females were taken with 6 mammæ in active service. A young one was found abroad on May 28th; most, however, appear in June, when half grown. They are incapable of breeding till their third year.[51]

Traps and Troubles

Though a very timid animal, the Mountain Beaver, according to Camp, "will fight fiercely when in a trap. Its clumsy movements seldom permit of its inflicting the injury that its strong jaws and teeth are well fitted to produce. When in pain, milky white tears of a sticky nature cover the small eyes of the creature."[52] An eagle has been seen at watch with obvious ill-intent by the Beaver burrow.[53]

"Traps set in Aplodontia burrows have caught Weasels, Skunks (both *Spilogale* and *Mephitis*), Mink, and Gray-fox (Dixon, MS., 1909); and Coons (Lord, 1866, pp. 346–358), Badgers, Wildcats, Fishers (Lum, 1878, pp. 10–13), and owls are to be regarded as possible enemies. Redsquirrels, Rabbits and Ground-squirrels share the animals' burrows or forage about their litter,"[54] so are enemies in a small and parasitic sense.

Anthony testifies[55] that "The Showt'l probably is not very extensively preyed upon by hawks or owls, owing to the dense cover of vegetation beneath which he works, and also to his nocturnal habits. However, predaceous animals use his burrows and runways, for 2 Weasels (*Putorius saturatus*) were caught on successive nights in one runway; and I was told that Skunks

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[49] Some data.

[50] W. A. N. A., p. 532.

[51] Some data.

[52] Excavations, p. 533.

[53] W. A. N. A., p. 53.

[54] Excavations, p. 533.

[55] Habits, pp. 58–59.

PLATE LXVII.—MOUNTAIN BEAVER, TO ILLUSTRATE WHISKERS
From photograph by H. E. Anthony

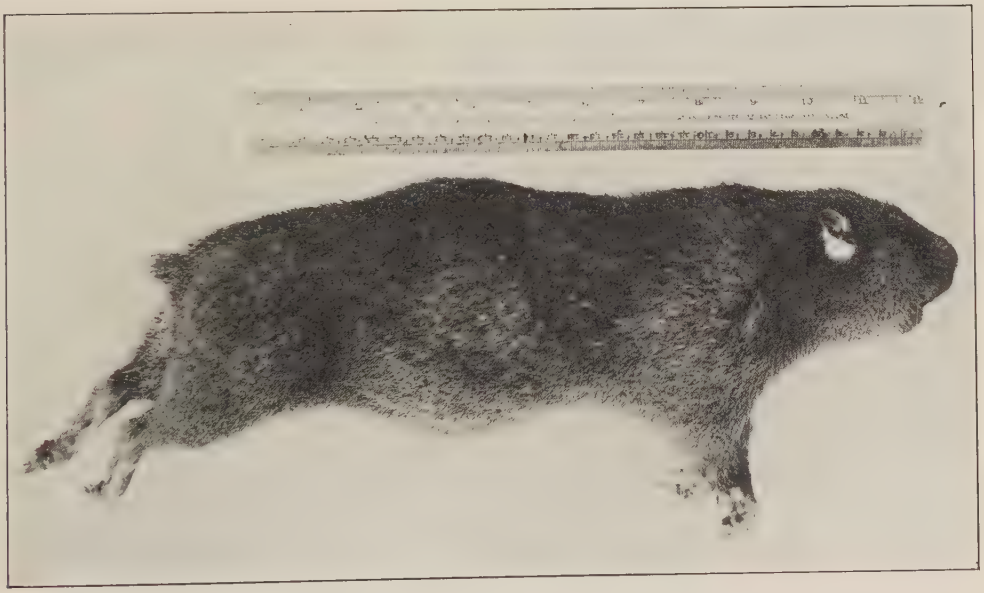

PLATE LXVIII.—MOUNTAIN BEAVER (DEAD)
From photograph supplied by the University of California. (Taylor's Revision)

(*Spilogale*) were not uncommonly caught by the farmers in traps set for" this poor simpleton.

Damage and Trapping

In a few localities the underground Beaver "does some damage by eating crops and interfering with cultivation at the edges of the fields. Grinnell (MS., 1912) records it as causing trouble along the line of the Union Pacific Railroad over the central Sierra Nevada 'by burrowing in the ditch walls.' Shelton (MS., 1916) says that, in western Oregon, *Aplodontia* makes itself a nuisance to foresters by undermining trails and causing washouts."[56] In other words, it does an amount of damage about equal to what a baby would do with a wooden shovel.

As a climax, Prof. D. E. Lantz of the Biological Survey[57] reports that in western Washington, "considerable complaint has been made of their depredations of crops, particularly small fruits."

It is wise always to discount stories of farm depredations; this is well known. Anthony relates the following experience with Oregon residents. "It was suggested by the farmers that some of the inroads upon potato fields were made by Showt'ls, on account of the presence of burrows on the adjacent uncultivated land. Traps set in the potato fields, if at any distance from the waste lands, did not catch *Aplodontia*, and I collected no very positive evidence to condemn the animal. The large Ground-squirrel (*Citellus grammurus douglasii*) was quite common in this region, and the credit for the damage to farm produce must be given in greater part to this animal and to the Chipmunk (*Eutamias townsendi*). No unquestionable *Aplodontia* burrows were noted running out into the cultivated fields."[58]

"Mountain Beaver are easily captured," says Camp, "and the usual method of trapping them is to set No. 0, or No. 1 steel traps in the tunnel entrances. The Indians (in Oregon and Washington) says Cooper (1860, p. 82) catch the animal with 'stone fall traps.' He adds that the skins were not then being bought by the Hudson's Bay Company. Gibbs (in Suckley, 1860, pp. 100–106) relates how the Indians, probably the Nisqually tribe in Washington, 'trap and eat them and make garments by sewing the dried skins together.' The animals were there caught in traps 'resembling the figure-4 trap.' Skins of the California species bring only from 8 cents to 10 cents in the market, so there is little danger that the Mountain Beaver will be exterminated as a result of the fur trade."[59]

[56] Excavations, pp. 533–34.

[57] Destroying Rodent Pests. Yearbook U. S. Dep. Agri., 1917, p. 16.

[58] Habits, p. 58.

[59] Excavations, p. 534.

Gifts and Gait

As usual with creatures that shun the light and air, sight and hearing are dim and dull in the Mountain Beaver. Its contact with the outer world is chiefly through the sense of feeling, and this is highly developed all over its body. "The slightest touch upon a hair," says Camp, "will be responded to instantly by quick jerking movements. The sense of smell seems to be good, for the animal has a way of frequently raising its nose to sniff; also the scent glands are well developed."[60]

The Mountain Beaver has no need to be swift of foot. Strong feet to dig are worth more to him than speed, so his choice was made—he is a powerful digger, but slow above ground. Dr. J. G. Cooper says of these animals:

"A young man who had kept school at Astoria told me that the children sometimes caught them about the schoolhouse, where they burrowed, and that they could be caught by running after them, as they did not run fast."[61]

This implies a daylight appearance above ground that is interesting; and may correspond with the noonday outdoor activity of several species of Moles and mining Gophers.

Observations upon a Showt'l in captivity, have shown that, like *Thomomys*, it runs as easily backward as forward—a reverse-gear possibility that must be extremely useful in the narrow burrows.

Non-aquatic

Because it looks like a Muskrat and claims kinship with the Beaver, one might expect this animal to be highly aquatic. Some writers have assumed it to be so. Anthony, however, writes:

"Much has been made of the semi-aquatic tendencies of this animal, which has been credited with seeking sites where water courses sometimes were in part deflected into their burrows. This is doubtless often the case, for the Showt'l seeks abundant green vegetation, and this is oftenest found where there is water. However, Aplodontia shows no marked predilection for water, since in the humid coast-belt, where Tillamook is situated, the rainfall alone is sufficient to induce luxuriant vegetation, and here the comparatively dry hillsides harboured many families of the Showt'l. From the behaviour of my captive animal, I believe that water is tolerated when it is a necessary adjunct, but is avoided when sufficient food can be found other-

[60] Excavations, p. 532.

[61] U. S. Pac. R. R. Expl. XII, 1860, p. 82.

wise. This may be so, however, only in the case of this species, and other forms may be more truly sub-aquatic."[62]

To this he adds of one that he captured: "This Showt'l was liberated on the bank of a small clear brook; and, as an experiment, he was put out into a fairly deep pool. He swam ashore showing no fear whatever of the water, but evidently displaying no particular fondness for it. He swam well and rapidly, and his unfrenzied procedure showed he had no dread of the water. He looked very much like a slowly swimming tailless Muskrat.

"Despite the fact that the Showt'l has been described in literature as being a water-loving animal, I do not think they ever swim from choice. He spent some time after coming ashore in shaking out his fur and going over his sides and belly before he felt sufficiently comfortable to begin eating."[63]

Dr. J. G. Cooper speaks of getting a specimen that was drowned in a tanner's vat[64]—which, if it proves anything, goes to show that the creature cannot maintain itself indefinitely afloat.

Climbs Trees

Perfectly logical naturalists have pointed out that, in view of its form and habits, the Mountain Beaver can no more climb a tree than can a Mole or a Muskrat. Then come the hunters and say, *But it does*. There can be no doubt, therefore, that this animal occasionally climbs. Camp writes:

"More than one writer, since Lewis and Clark, have mentioned the climbing habit of Mountain Beavers; and the evidence seems to be good that, at least, the Oregon and Washington coast species climb into low bushes for food (see Lum, 1878, pp. 10–13). The Mountain Beavers on the grounds of the University of Washington at Seattle have been seen climbing."[65]

Thus, it seems to climb about as much as our Woodchuck. And I suspect that, as with that animal, the climbing habit will be found oftenest in the young ones, for they are less removed from the ancestral stock, which most likely was a climbing animal.

A Night Bird

There can be little doubt that this grotesque and gloomy little creature is as strictly nocturnal as any creature is ever strictly anything. Anthony

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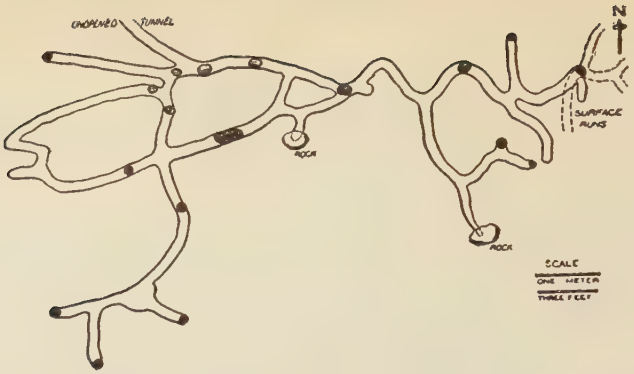
[62] Habits, p. 58.

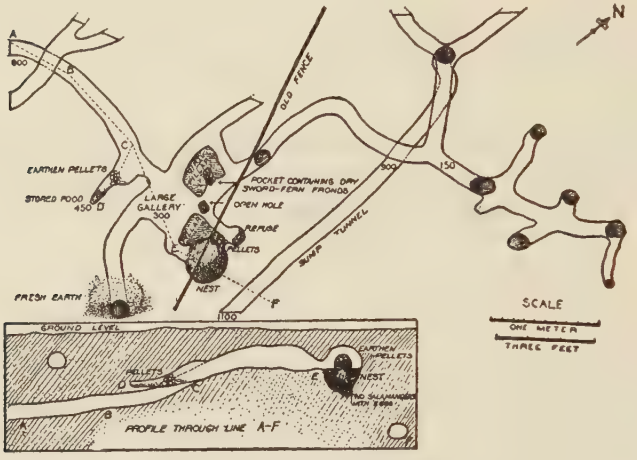
[63] As above, p. 56.

[64] Monog. Rod., p. 596.

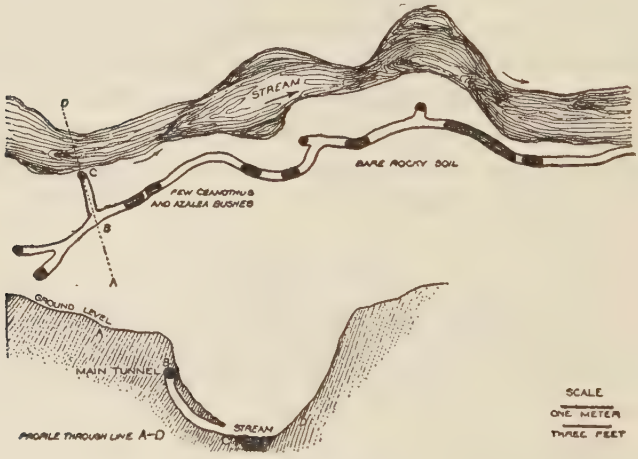
[65] Excavations, p. 530.



Plan of underground tunnels in colony of *Aplodontia rufa phaea* excavated near Point Reyes, Marin Co. Calif. All tunnels shown were within 600 millimeters of surface of ground



Plan and partial elevation of nest-galleries of *Aplodontia rufa phaea* excavated near Point Reyes, Marin Co., Calif. Numbers on plan indicate depth in millimeters beneath surface of ground



Plan and partial elevation of burrow system of *Aplodontia rufa californica* excavated at Chinquapin, Yosemite National Park, Calif.

PLATE LXIX.—BURROWS OF MOUNTAIN BEAVER

From Chas. L. Camp's Paper

says of those he investigated in Oregon: They "can rarely be seen during the day. Although a number of runways were visited, and I was daily in places where evidences of activity were manifest, I saw none of the animals themselves. Those caught in traps were frequently alive when the rounds were made in the morning."[66]

No Winter Sleeper

In the warm southern and southwestern parts of its range, where there is little or no white winter, the Mountain Beaver most assuredly loses not one day because of any hibernation. Camp says that in California the "Mountain Beaver, even in the high mountains, are certainly active during the winter. Near Olema, in Marin Co., [it] has been trapped at its burrow entrances, during the latter part of November. In the Yosemite National Park, at elevations of from 6,200 to 8,600 feet, [its] winter work . . . has been observed—young pine, fir and cedar trees with the limbs trimmed off up to 10 feet above the ground, and with twigs trimmed from one side of the trunk only, as if worked on when the trees were bent down in the snow. Azalea and other thickly growing bushes with the tops trimmed off evenly a foot or more above the ground, indicate that the animals probably forage on top of the snow."[67]

Going farther north into the land of hard winter, at least on the higher levels, Lum reports that in Oregon and Washington "they do not hibernate, but keep their burrows open all winter; beaten trails in the snow are often seen, leading above ground for a few feet from one hole to another. They are able to gather their food at any time of the year, seldom going more than a few feet from the entrance of their holes to procure it."[68]

Dr. J. G. Cooper says: "An old Indian hunter, who is now a shepherd in the employ of Dr. Tolmie at Puget's Sound, told him that he had frequently seen them running over the snow in the Nisqually Valley, so that they probably do not hibernate."[69]

"Suckley (in Suckley and Gibbs, 1860, p. 124) learned from the Nisqually Indians that the Mountain Beaver moves about a little during the winter but does 'not become decidedly active till late in the spring.' Lord (1866, pp. 346–358) maintains that the animal only partially hibernates—this of the species, in British Columbia. Matteson (1877, pp. 434–435) believes that it hibernates, covering the entrance of the burrow with stalks

[66] Habits, pp. 53–54.

[67] Excavations, p. 531.

[68] Sewellel, pp. 10–13.

[69] Monog. Rod., p. 596.

of leaves and fern. Bretherton (1895, p. 124) says that they do not hibernate."[70]

It will be noticed that no one yet has offered the important physiological evidence of a vast accumulation of fat next the creature's skin in autumn, which is usual in hibernating animals.

"In winter," says Nelson, "much of the Mountain Beaver country is buried under several feet of snow, but this does not stop the activities of this hardy animal. Between the entrances to its burrows and out along the surface of the ground, it tunnels through the snow in various directions in search of forage.

"At this time, it cuts twigs from bushes and gnaws bark from the trunks and roots of the smaller trees, sometimes completely girdling and killing trees more than two feet in diameter."[71]

His Way of Life

This Mole-gnome of the thick woods seems to live a life as sombre as ever was pictured for the underworld gnomes of our fairy books. He seems positively to dread the sunshine.

Nelson testified that "Although mainly nocturnal, the animals are active early in the morning and late in the afternoon, as well as throughout dark days. Those kept in captivity would show periods of restless activity at night, and have alternating periods of sleep and wakefulness during the day. Sometimes they would sleep coiled with the head turned under the body, and again flat on their backs. During these periods, their sleep is often so profound that they may be handled without being awakened."[72]

Allan Brooks offers some light on the creature's gifts and little mind. "The eyes," he says, "are exceedingly small, and generally covered with a milky film; they do not seem to be of any use to the animal, as the following incident will show. I had set a trap in the mouth of a hole, and next morning found two 'Mountain Beavers' jammed in the hole, fighting the trap. I thought at first both were caught, and got down on my hands and knees to examine them, when I saw that only one foot was in the trap. After careful selection, I grabbed by the nape of the neck, as I thought, the free animal, and dragged it out, but found I had the trapped one. The other bolted down the hole before I could make another grab.

"Another time I wished to liberate one which was almost without hair on the anterior half of its body, and therefore of little value as a specimen.

[70] Excavations, p. 530.

[71] W. A. N. A., p. 532.

[72] As above.

I sprung the jaws of the trap open, while the animal made a vigorous onslaught on my feet. When free, it still continued to fight. Twice I kicked it down its hole, only to have it rush out and attack my feet again. The third time, it scuttled down its hole out of sight."[73]

Anthony's observations on captives of this species, are the most minute and complete that are available. He says:

"Showt'ls, when caught in the trap without serious injury, are very pugnacious; and at such times, when two are brought together, fight ferociously. They will bite fiercely at sticks or any objects thrust near them, and I imagine that, under ordinary circumstances, this pugnacity would serve to keep the inhabitants of a series of burrows few in number. Their resemblance in behaviour to the Pocket-gopher, under similar conditions, indicates that the Showt'l may have the same surly home life.

"An animal caught in a steel trap by the leg, but with no bones broken, was found the morning of July 28, and was kept alive to observe his habits. He was very aggressive while in the trap; and when brought near another captive, also uninjured, after the first tussle, he created such a respectful attitude in Showt'l No. 2, that the latter strained at the chain to keep out of his reach. They were separated before either had been hurt, for the powerful incisors and strong jaw muscles are capable of giving deep wounds. While in the trap, great care in handling the animal had to be exercised. He was placed in a box, and kept from escaping by a board laid across the top.

"Before he had been in captivity 24 hours, he was taken out to be photographed. A wire fastened to a hind leg prevented escape; and he was put down in a spot resembling his habitat.

"After several determined efforts at escape, he suddenly stopped his struggles, and grabbing a tender young shoot of the 'elk-brake' by which he was surrounded, proceeded to feed as quietly and as unconcernedly as if he were perfectly free. He was quite touchy, however, and any sudden movement brought forth an attempt at freedom. He sat up a great part of the time, and if annoyed while in this attitude sparred like a Bear with his forepaws, showing a perfect control of his position. . . .

"This captive animal washed his face after the manner of small mammals, reaching back with the forepaws onto his shoulders and hinder neck readily, the movements being short, quick dabs. When irritated, he twitched the whiskers energetically; and when most angry uttered a husky querulous note somewhat like a cough. He often satisfied his curiosity by sniffing and working his nose, and this member seemed to be very sensitive, for the

[73] Recreation, p. 259.

slightest blowing upon it produced spasmodic starts. When aroused, his eyes had a bright alert appearance, but quickly took on a dull listlessness when the animal relaxed at ease.

"His body was very hard and firm to the touch. When running loose on the floor and I put my hand upon him, he seemed to brace himself and became rigid at times. He could give sharp scratches when held, but did not seem to be able to squirm very effectually because of his short thick neck and the heavy musculature of the fore parts.

"By the end of a week, he had become so tame that he never offered to bite. He seemed to accept the conditions as inevitable, and, not showing any appreciation of caress that some tame animals display, his attitude was one of complete indifference.

"He soon cut off the toes from the foot that had been pinched in the trap, but evinced no concern over the fact. No attempt was made to gnaw out of the box that kept him prisoner."[74]

This individual was in captivity for weeks, and at least enabled us to get a glimpse of his home habits.

But the species seems to be too sensitive and too specialized for cage life, and practically all attempts to keep it indefinitely a captive have failed. Though it seems to eat freely and live contentedly, it does not thrive, but dies early for no obvious reason.

Unsociable and Gloomy

Although found in colonies like the Muskrat—by reason, perhaps, of the abundant food supply at a given spot—the Mountain Beaver is not sociable in the sense that the Beaver is. It does not unite its efforts for some common good, such as a common nest, or a common food supply, unless digging long connecting tunnels can be considered a joint and sociable undertaking.

This unsociable bent is further shown in the total absence (so far as known) of mud-pie communication (see Beaver Life, p. 480), or of any large nest that is resorted to by many, in the way of a club-house; as well as the practical absence of voice, according to many observers—with, however, two notable exceptions that are set forth later. Nevertheless, we are not equipped with full observations, and a complete change of ideas is quite possible in view of the following facts: The species does live in colonies; and it has a strong musky smell. Such smells are usually associated with some method of communication, which presupposes ideas, and the wish to communicate them.

[74] Habits, pp. 55–57.

Struthers thinks that the species may breed twice each year, as he has seen young ones of but 2 or 3 pounds weight in September and in January.

The Big Little Ones

The young are said to be 1 or 2 in number, sometimes 3, rarely 4. Nevertheless, Struthers writes me that in over 79 pregnant females observed, all had but 1 fetus each.[32]

Bellalise tells me that in April, travelling through the deep snow, he once found a Porcupine and her two jet-black young ones. They were rather smooth, and had long, thick tails. This was on the south side of Lake Athabaska.

According to Merriam,[33] they "are born about the first of May [in the Adirondacks], and are monstrous for the size of the species. They are actually larger, and relatively more than 30 times larger, than the young of the Blackbear at birth. . . .

"May 1, 1882, I shot, at Big Moose Lake, a female Porcupine which contained a foetus that would certainly have been born within three or four days. It weighed $1\frac{1}{4}$ pounds avoirdupois (567 grm.), [a Blackbear at birth weighs about $\frac{1}{2}$ lb.] and measured in total length $11\frac{1}{4}$ inches (285 mm.), the head and body measuring about $7\frac{3}{4}$ inches (just 195 mm.). It was densely covered with long, black hair; and the quills on its back measured a little over half an inch (13 mm.) in length. The discoid placenta measured $2\frac{1}{4}$ inches (57 mm.) in diameter."

Concerning the further development of the young, I have no information beyond the fact that, early in August, I found young Porcupines half-grown in the Adirondacks, and already leading independent lives. What time they begin to leave the nest; whether they follow their mother and are cared for by her; and at what age they are fully grown, have not yet been recorded.

All observations at hand go to prove that the father takes no interest in his offspring.

Food when Aloft

In the winter, its native food is supposed to be exclusively the bark and twigs of hemlocks, aspen, jackpines, elm, basswood, cottonwood, and other trees; of these, its favourite is hemlock. Its method of feeding is thus described by Merriam:[34] "When he has selected and settled himself in a tree to

[32] Notes.

[33] Mamm. Adir., p. 305.

[34] As above, p. 302.

his liking, he may not leave it day or night until he has denuded it of the whole of its foliage. I have seen many hemlocks thus completely stripped, not a green twig remaining, even on the smallest bough. It seems incredible that so large and clumsy an animal should be able to climb out far enough on the branches to reach the terminal leaves; but he distributes his weight by bringing several branches together, and then, with his powerful paws, bends back their ends, and passes them through his mouth. When high in the tree tops, he is often passed unnoticed, mistaken, if seen at all, for the nest of a crow or hawk."

There is a tradition in the Northwest that the Porcupine never kills a tree if he can help it; carefully avoids a complete girdling of the bark. In jackpine woods, I have seen a great many instances that *looked* like this. But the fact is, the Porcupine climbs up to some comfortable crotch, and then gnaws at all the bark within easy reach. If there are crotches on both sides, he is likely to girdle the tree; if not, he takes the easiest way, which may mean go halfway around, then move to another fork.

The Southwestern Forest Experiment Station of Arizona reports that "in one series of experiments, a single small Porcupine weighing 8 pounds, gnawed off 34 square inches of bark in a single night. Another of 13½ pounds weight, disposed of 196 square inches in 6 days in a forest area about 90 feet square, choosing two large trees and 17 small ones. A third, a 12 pounder, took 300 square inches of bark in 6 days, girdling and killing 39 seedlings, and gnawing 32 others, as well as 5 large, young pine trees."[35]

Food when the Ice Is out

In the summer, its diet is more varied; doubtless, it eats all kinds of foods that are allowable to a strict vegetarian. Its fondness for lily-pads is well known, and is thus referred to by Merriam:[36]

"When feeding on lily-pads along the borders of watercourses, they sometimes utter extraordinary noises; and occasionally quarrels arise for the possession of some log which affords them easy access to the coveted plants. At Beaver Lake, in Lewis County, Mr. John Constable once witnessed an encounter during which one of the combatants was tumbled into the water. The animals did not attempt to bite, but growled, and snarled, and pushed."

Herrick[37] has given us interesting light on this food habit. He relates that, while out one July night, canoeing with jacklights: "Some heavy

[35] Forest & Stream, Dec., 1924, p. 729.

[36] Mamm. Adir., p. 303.

[37] Mamm. Minn., 1892, p. 247.

animal comes down to the water's edge where the banks are covered with a new growth of arrow-head leaf (*Sagittaria*), succulent and green; for it is June, and the receding waters have but lately exposed the roots to the sun. The clatter of teeth is again heard very loud and inexplicable, until we make out the gray form of a burly Porcupine, which at once starts up the bank much as an overfed Hog might do. A shot brought the animal to the water's edge. Another shot made it ours, and we found it an immense animal measuring over 3 feet from its blunt muzzle to the end of the spiny tail. The stomach of this specimen, a full-grown male, contained nothing but the finely comminuted shoots of *Sagittaria*."

Alvin R. Cahn says that in Itasca Co., Minn., the Porcupine "prefers the hardwood thickets, and feeds largely on the top-most branches of the ash (*Fraxinus americanus*) and the aspen (*Populus tremuloides*). Along the lake shores, it feeds upon the succulent stems and roots of the arrow-heads (*Sagittaria* sps.) and the white water-lily (*Castalia odorata*)."[38]

In amplification of this, Dr. C. E. Johnson says: In Minnesota "the majority of the Porcupines seen were met with while they were feeding at the edge of some lake or stream. In a number of instances, they were observed eating the rhizomes of water-lilies that had been pulled up by the Moose. The Porcupines were at times seen to secure this food, and no doubt also other kinds found in such places, by reaching down into the water full-length of the arm, feeling about until some object was encountered, and then hauling it in with the hand."[39]

This prepares us for the statement attested by several that the Porcupine follows the Moose around to profit by the roots of water-plants pulled up by the big brute as he feeds on the rhizomes of the lily.

Struthers details a case in which the Porcupines ruined a 3-acre field of corn, devouring it in less than a week. This was near Nelson, N. H.[40]

A Salt Addict

There is one very marked departure from its vegetarian diet that the Porcupine continually makes; and that is, it eats any sort of salt pork or butter that it can find, doubtless disliking the grease, but forcing it down for the joy of the salt. It is so keen after this delicacy that it will gnaw up every bit of wood that tastes in the least degree briny.

I have many times visited old mining shacks in the Rockies and lumber camps up the Ottawa, to find that the common fate of every wooden article

[38] Journ. Mamm., May, 1921, p. 72.

[39] As above, Feb., 1922, p. 38.

[40] Notes.

of furniture in the kitchen, from the meat block to the soup ladle, was to be devoured by Porcupines for the sake of the salt they held. It seems to be this weakness that brings them about the camp, where they are such a nuisance; and this, therefore, more than any other trait, brings on their death sentence from man. Doubtless, it is this hankering for salts and grease that makes them gnaw the cast antlers of Deer.

I think it likely that the craving for salts is the explanation of the following by O. J. Murie, concerning the Yellow-haired Porcupine in Alaska. He says: "Early in June of 1921 . . . on the Robertson River, I found Porcupines abundant on the river banks and sand-bars. Judging by my observations at that time, the Porcupines were feeding exclusively on mud. I watched many of them, and almost invariably saw that they were licking or chewing the fine sandy soil of the bars or river bank. At a distance of a few feet, one could hear the gritting of the sand in the animals' teeth, and could plainly see that there was not a vestige of vegetation near."[41]

The Quills

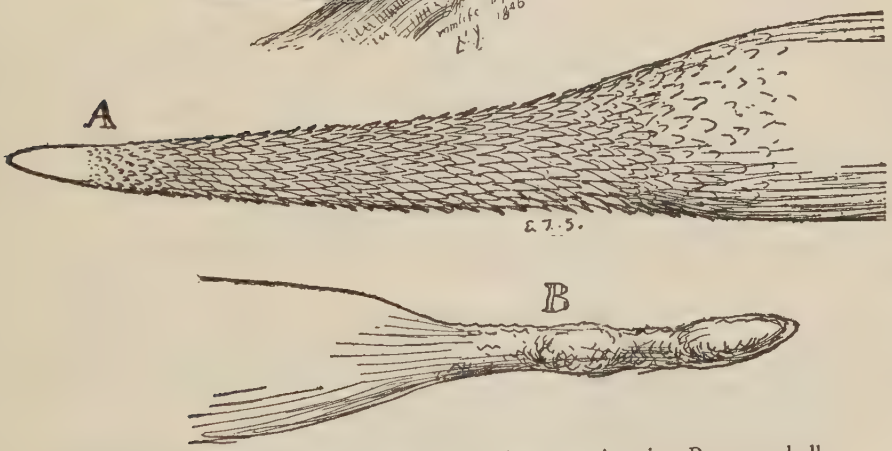
But the central thought in the Porcupine, the wonderful peculiarity, the secret of its life indeed, is its quill equipment. To specialize and grow quills, it has relinquished speed, cunning, and keenness of senses; all the revenues of its body seem to have been converted to the growing of those awful spines; and in the primitive times, when first evolved, the idea was absolutely justified by results.

The quills are about one inch long on the head, and 4 inches on the back; they are absent from the muzzle, the underparts, and the legs. They are so hidden in the wool and hair that they are hard to see, but are always unpleasantly easy to feel. They are so thickly placed that a Porcupine stripped of its wool and hair, as I have seen it by partial decomposition, is still clad densely with quills; each of these is a keen, many-barbed, and poisonous dagger.

Through the courtesy of the Geological Survey at Ottawa, I have had the opportunity to make an enlarged drawing of a representative quill (Plate LXXV, p. 619). The specimen was taken from the back of a stuffed Porcupine (*E. dorsatum*). I expected to find those of the tail more highly specialized, but was disappointed. Examples from head, back, and tail differed chiefly in size.

The extreme point is polished and keen. Very soon, i.e., after $\frac{1}{32}$ of an inch, the barbs begin to show; these die away on the shoulder of the quill. I reckoned up a round thousand barbs on this specimen. When soaked in warm water, they stuck out much more; so we may believe that they also

[41] Notes, May, 1926, p. 111.



Quill from back of Porcupine; magnified 14 diameters. A, point; B, root or bulb

PLATE LXXV.—PORCUPINE DETAILS

flare out when in the warm flesh of the victim. The barrel is smooth, and highly polished. The bulb or root presented no special features.

A large male, taken at Berlin, Rensselaer Co., N. Y., Jan. 14, 1924 (No. 67892 Am. Mus.), on careful examination by G. G. Goodwin and myself, gave the following as conservative results of a count:

Head (armoured part)			$12\frac{1}{2}$	sq. in.,	100	quills	per	sq.	in.	1,250
Body	"	"	240	" "	140	"	"	"	"	33,600
Tail	"	"	16	" "	100	"	"		"	1,600
										36,450

A representative female collected at the same place by Goodwin, gave, on careful calculation, a total of 24,480 quills.

Thus, Porky is protected by over 30,000 poisonous daggers, each more dangerous than the sting of a wasp! Imagine having 30,000 fearless wasps eternally on guard for your protection!

Thirty of these quills will repel a Dog; therefore, each Porky, we may say, is equipped to defeat 1,000 Dogs, as quickly as they care to come on.

How long it takes to grow a quill, is not known. But no one ever saw a wild Porcupine with bald spots, or any apparent shortage of spears. I suspect that, after even a serious affair with some enemy, the Porky will be wholly requilled before three months have passed by.

Are the Quills Shot?

The quills on the head and body are defensive; those on the tail are offensive, for the latter is thrashed about vigorously at a foe. The daggers, as a rule, leave the creature only after the point has entered the enemy; for, at the Porcupine's end, the quill is very loosely set in, and at the foeman's end, it is very tightly fixed, once it enters; and it has a thousand barbs to rankle and clinch, and defy all efforts to remove it.

Whether the festering of a quill-wound is due to an active poison on the point, or to the barbs, is unknown.

The quills, as is well known, are daggers, not arrows; for the creature does not shoot them at his foeman. Nevertheless, there can be no doubt that they are sometimes *thrown*, in a limited sense. Thus, L. V. Shaw, of Clements Port, Nova Scotia, writes on this subject:

"By a sudden jerk of his powerful tail, I have seen him throw loose quills a good distance; and if your flesh was close enough, probably [they would] stick in, and left serenely alone, would surely go through you."[42]

[42] Forest & Stream, June, 1924, p. 346.

Alexander H. Leighton, of Rosemont, Pa., says: "While hunting with a camera in the woods of Nova Scotia, during the summer of 1923, I saw a Porcupine, not 'shoot,' but throw his quills at least 5 feet, and strike a man. We found this Porcupine in a tree which we cut down; and my guides, with the aid of long, forked sticks, began driving him toward an open place where I should have light enough to photograph him. Suddenly, he took a notion to charge down a little path in a direction we did not wish him to go. One of the guides jumped in front of him, and held out a stick at arms' length to stop him. The Porcupine flicked his tail, and sent two quills into the guide's shoulder." Of course, as Leighton concludes, "the quills in the Porcupine's tail were loose, and struck the guide merely by accident."[43]

Unexpected use for the tail is announced by O. J. Murie. He says of a Porcupine that he watched closely: "Slowly and cautiously, it would hitch its way up the trunk, using the tail as a prop. The stiff bristles on the under surface were very useful here."[44] This carries us back to woodpecker methods.

On the Defensive

How are these daggers used? The creature does not curl up into a many-rayed globe—Hedgehog or globe-fish fashion—as some have told. I have tried many times to make it do so, without success. Indeed, if the animal be turned on its back (and it costs the investigator much effort to turn it, as it is sturdy on its legs), it lies exposed and helpless; which would not be the case if it had the habit of making itself into a ball. The old hunters say it never does so, except, perhaps, when falling from a height; and then it opens out on striking the ground. After many opportunities to observe, I can state that, on meeting an enemy from which it cannot escape, the Porcupine tucks its head under a root, a log, or other cover; raises its quills, radiating them all ways from the small of the back, and lashes with its tail at the slightest intimation of the foe being near. If it has no cover for its head, but happens to know of one in the direction of the enemy, it backs toward that switching its tail to clear the way. And there be few creatures indeed that do not heed the warning.

An adult female which I caught on the Oswegatchie, N. Y., was held with a noose on its hind foot while being examined. The foolish thing so resented this indignity that it lashed its own out-stretched foot full of quills; and it cost us no little trouble to get them out—as we felt in honour bound to do—before we let the fretful one go free.

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[43] Journ. Mamm., Feb., 1926, p. 61.

[44] As above, May, 1926, p. 112.

Meeting Open Attack

Bachman has left us this very exact picture of the Porcupine repelling a foe:[45] "A large, ferocious, and exceedingly troublesome mastiff, belonging to the neighbourhood had been in the habit of digging a hole under the fence, and entering our garden.

"Early one morning, we saw him making a dash at some object in the corner of the fence; which proved to be our Porcupine, which had, during the night, made its escape from the cage. The Dog seemed regardless of all its threats; and, probably supposing it to be an animal not more formidable than a Cat, sprang upon it, with open mouth. The Porcupine seemed to swell up in an instant, to nearly double its size; and as the Dog pounced upon it, it dealt him such a sidewise lateral blow with its tail as caused the mastiff to relinquish his hold instantly, and set up a loud howl in an agony of pain. His mouth, tongue, and nose were full of Porcupine quills. He could not close his jaws, but hurried open-mouthed out of the premises.

"It proved to him a lesson for life, as nothing could ever afterwards induce him to revisit a place where he had met with such an unneighbourly reception. Although the servants immediately extracted the spines from the mouth of the Dog, we observed that his head was terribly swelled for several weeks afterward; and it was two months before he finally recovered."

What dreadful punishment, in spite of immediate and skilful human aid! What would have been the offender's fate had he been a wild animal? Assuredly, death. The records of natural history abundantly prove it.

The Fools in Their Folly

"We have mentioned in our article on the Canada Lynx," says Bachman,[46] "that one of those animals was taken in the woods in a dying state, owing to its mouth being filled with Porcupine quills. We have heard of many Dogs, some Wolves, and at least one Panther, that were found dead, in consequence of inflammation produced by seizing on the Porcupine."

Manly Hardy lists the Fox, the Raccoon, and the Wildcat, among those he has found dead, slain by the quills of the Porcupine.[47]

On Sept. 16, 1901, in Rio Blanco Co., Colo., I found a Fox at the point of death from the quills of a Porcupine that he must have attacked some weeks before.

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[45] Q. N. A., I, p. 281.

[46] As above, p. 285.

[47] Shooting and Fishing, April 13, 1899, p. 526.

In the Blackbear Life (Vol. II, p. 145), is related the frightful punishment and miserable death of a Bear that essayed to make a meal of the Quiller.

Charles A. Wilding, of Fort Wayne, Ind., tells me that during a fishing trip into Canada, he once captured a huge snapping turtle whose fore feet were stuck full of Porcupine quills (Dec. 17, 1920).

A remarkable case of a horned owl, shot shortly after it had attacked a Porcupine, is detailed by C. E. Eifrig, of Ottawa, Ont.[48] It took place in Dec., 1907, at a place 50 miles northeast of the city; 66 Porcupine quills were taken out of that misguided owl's body.

In *Forest & Stream* of March 20, 1884, p. 144, J. L. Davidson, of Lockport, N. Y., states that he had recently examined a golden eagle that had been shot at Plessis, Jefferson Co., N. Y. He says: "The feet of the eagle were full of Porcupine quills, which was probably the last animal he had dined off."

In the *Auk*, April, 1922, p. 259, is an account by Albert Lano, of Fayetteville, Ark. It details the defeat and ultimate death of a golden eagle that tried to destroy a Porcupine.

An even more tragic affair has just been reported to me by the Postmaster of Laingsburg, Mich. Milton Williams, of that town, found an American eagle dead, and filled with quills that had evidently caused its death. Without doubt, the eagle had attacked the Porky, and had paid the extreme penalty of his folly.

A careful search in the annals of natural history will eventually put on the list of "killed by Porcupine" every savage flesh-eater in the region where the Quill-pig dwells.

A Cranky Bedfellow

The final and most amazing instance of the Quill-pig's power is found in the following. It is suggestive of the female spider that makes a practice of destroying her husband the morning after the wedding night. Dr. George W. Harvey, telling how his boy and his Dog Bose managed to do a Porky to its death, says:

"The next afternoon, the boy skinned and dissected the Porky, just to see what he had been eating, and how he was made. He first found that Bose had bitten the Porcupine's backbone in two in two places; and second that his intestines were perforated in no less than three different places by three of his own, a rival's, or his lady-love's quills, which, if the latter, would be Cupid's darts literally. In each instance, the quills were entirely through the

[48] Auk, Jan., 1909, p. 58.

intestine; an end protruding from either side, and held in place by a spindle-shaped ball of fecal matter, that must have revolved as the waste moved through the bowel like a shaft bearing a pully.

"In spite of these intestinal perforations, the Porcupine was as fat as a Seal; evidently in perfect health, and enjoying life to the full."[49]

Who Shall Make Him Afraid?

Who, then, are the enemies that this fearless one should fear? Setting the least first, we must begin with forest fires. The Deer and the Wolf can run before them or turn aside to purer air. But the slow Porcupine is enveloped in stifling fumes that extend their path of death for miles down-wind; and the higher he climbs, the surer his fate. For three years after the 1898 forest fire on the White River Plateau of Colorado, no Porcupines were seen.

But the fire is local and transient. The knight of many spears carries a worse foe within his own coat of mail—invisible, hidden, incombatable—and such are ever among the deadliest of foes. The measure of their damage is not known; and yet, of this we are assured: There are none worse. This secret plague, like the secret thought that dissolved an empire's army not so long ago, is no more than a worm—a tapeworm—the body-sapping *Bothiocephalus*.

The Terrible Pekan

It will be noted that in the list of creatures that fear the Quill-pig, we do not find the Pekan-Fisher. For reasons not understood, but set forth—as far as known—in the Fisher Life (Vol. II, p. 476), the Fisher is immune to the quills. He has no fear of Porky's attack. He loves Porky meat, and makes of him his favourite prey in countries where the Quiller still abounds. He is the chief natural foe of the Porky.

As we have already seen, there is a close relationship between the number of Porcupines and of Pekans in eastern Quebec. Similarly, the clearing out of the Pekans in western New York about 1820, was followed by conditions thus recorded: "Mr. Cozzens states that, of late years, they [Porcupines] have multiplied greatly; and are become numerous near Oneida Lake and in the northwestern part of the State of New York."[50]

As already noted, the Spiny's position of defense is with head thrust under any log or root; or, failing that, between his own fore legs, his belly hugging the ground, while his tail with lashings much more dreadful than those of Lion or Bull, girds blindly at the foe. But the Pekan, with foxy

[49] Forest & Stream, May, 1926, p. 280.

[50] J. & T. Doughty's Cabinet of Nat. Hist., I, 1830, p. 242.

craft, and arrowy speed, attacks, not with foolish canine jaw, but, with insidious catlike paw inserted underneath; upsets the dull, dazed skinner of the trees, and tears his belly open ere he can regain his invulnerable pose.

Why the Pekan does not suffer as do others of the red-toothed kind, is unknown. He is prodded and speared as others are; yet seems to live. Once only have I heard of a Fisher that succumbed to the barbs of the vengeful Quill-pig.

If he escape the attacks of all these foes, and succumb not to the traitor in his bowels, how long may Porky live? The only testimony at hand is this —that at White Fish Lake, Mich., was an albino Porcupine that George Shiras 3d photographed successfully for 6 consecutive years;[51] from which we may argue that the species may live at least that long. By the rule of 5 times the period of growth, the Porcupine may, barring Pekans and other accidents, live to the ripe age of 10 or 12 years.

When He Meets a Skunk

On the title page of this volume are figured the two Invincibles of the Woods—the two that have the right of way, the fear-born reverence of all dwellers in the wilds—the Skunk and the Porcupine. When these two meet—when the invincible meets the invulnerable—what next?

Enos Mills alone was privileged to see that meeting, and thus reports it: "Dull fellows well met were Skunk and Porcupine. These dull-brained but efficiently armed fellows are conceded the right of way by conventional wilderness folk. They blundered to head-on clash. Never before had this occurred. Each was surprised and wrathy. There was a gritting of teeth. Each pushed and became furious. Then the Skunk received several quills in the side, and, in turn, the Porcupine a dash of Skunk spray. Both abandoned the trail, sadder but not wiser."[52]

The Skunk would pay the heavy penalty, after weeks of pain; the Quill-pig would recover in three days. Is not this a proof of which has better weapons?

Worst, last, and deadliest of the Quill-pig's foes is man, as we shall see.

Porky Damage

Man has been the inveterate enemy of the Porcupine for three main reasons:

[51] Nat. Geogr. Mag., June, 1911, pp. 572–91.

[52] Watched by Wild Animals, 1922, p. 120.

First, damage to the hunting Dogs. Dogs are courageous enough to attack any foe, when they know that, backing them, is a man with a gun. In such a cocksure attitude, then, the Dog goes forth to destroy every living thing that it can find in the woods. It meets a baby Rabbit or a stranded half-grown Woodchuck, and on this it works its valiant will. Then it meets a Porcupine, and rushes mouthily upon him—to receive the punishment that a bully deserves.

"Around Anaconda, Mont.," writes T. L. Holliday, "the dog-lovers rightly consider the Porcupine a curse. I, for one, never let one escape if I can help it. We dare not go . . . hunting with the Dogs without taking our long-nosed electrician's pliers with us; for we never know when we will have to pull quills, and this tool is indispensable, especially to reach spikes that are far back in the mouth and on the tongue.

"In some cases, when Dogs are badly quilled, . . . and ether or chloroform is unavailable, it is impossible to save the Dogs. The two bitches . . . and one other old battler, 7 years old, were put under ether, and gone over very thoroughly, taking our time; but in spite of our care, I am yet pulling an occasional quill that works to the surface, point first. Yesterday, I took one out of the corner of the eye; to-day one came out through the very end of the nose; it has come up between the lip and the teeth."[53]

After one or two such experiences, some Dogs learn wisdom; but most do not.

Allan Brooks says:[54] "There are Dogs so pugnacious they attack every Porcupine they find, year after year. I once knew a bull Dog that killed dozens of them. Of course, he always got his face full of quills; and after the fight, would present himself at his master's house to have them pulled out. He was a big, powerful brute, and it always took two men to hold him while a third played dentist. Some of the quills would break off, leaving the barbed point imbedded in the flesh. These would invariably work through the Dog's head, and come out on the opposite side. Frequently, his head would, for a week or two, be swelled to twice its normal size. Running sores would result from the action of the quills; but still the plucky Dog would go after the Porcupines, even while his head was swelled till it looked like a Yankee pumpkin."

The fact that man is at hand with pinchers and salves does not, by any means, guarantee that the Dog will be all right in a month. In spite of immediate help, many a Dog has paid with his life, for an attack on the Tree Skinner. Yes, one may state it with even greater vigour—thousands of Dogs

[53] Field & Stream, Nov., 1921, p. 739.

[54] Western Porcupine, p. 343.

have been killed by the combination of the Quill-pig's weapons and their own destructive folly. For this reason, all dog-men hate the Porcupine, utterly forgetting that Old Quills was never the aggressor, but was, in each case, merely defending his life in an unprovoked and unfair attack of 20 to 1 against him.

His Worst Crime

But the blackest crime with which our hero is charged is one that touches man's pocketbook. A stand of good timber is wealth; and the amount of potential wealth that one Porky can wipe out in a winter, is appalling.

Bachman credits the creature with destroying 100 big trees in a winter by girdling the bark.[55]

W. T. Cox, the lumber-cruiser, reporting on the conditions in the Minnesota pineries, says: "Careful note made as to the work of these animals, showed that each one had recently girdled and killed on an average 4.9 white pine trees. The trees were of an average diameter of 15 inches, representing the equivalent of 950 board feet of timber killed by each animal, or a total of 69,500 board feet on the 26 forties. This timber has a stumpage value of $8 per thousand feet. It will be seen, therefore, that the Porcupines of Itasca Park and Forest are killing each year approximately a million and a half feet of timber, worth on the stump $16,264, or approximately 1.2 per cent of the present annual growth. They constitute a source of damage which must be reckoned with in the management of the property."[56]

As a Camp-wrecker

Once a Porcupine has discovered your camp with its store of soups, salts, and flesh-stuff, nothing will restore peace by night but a wholesale massacre.

"To leave the soap out overnight," says Brooks,[57] "in a Porcupine country, means you will have to use sand to scrub with, the rest of the trip. The Porcupine will invariably get into any trap set for more valuable animals; and after eating up the bait, will sit comfortably down and await events, without trying to pull out."

In some mining regions, where rubber hose or automobiles are in use, the Querulous Quiller has developed a taste for rubber that adds to his unpopularity.

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[55] Q. N. A., I, p. 283.

[56] American Forestry, March, 1923, p. 161.

[57] Western Porcupine, p. 343.

You may drive him away, or shoot his wife or brother at his side—he will be back before you have been asleep more than ten minutes, to rattle his teeth on your saucepans, rasp and chip on the stock of your gun, squeal and whine and stamp as he squabbles with his friends. There is not a piece of wood in camp that he will not destroy if it be redolent of pork grease, or of sweat.

For these things, he is hated by campers.

His Service

Against infrequent fires and winter-famished Fishers, the Porcupine could still hold out. But man, in addition, was overmuch, and the balance turned. Quills grew scarce in all the lumber-woods.

Then a new thought came. Lumber-cruisers in the pineries got lost from time to time; and, armed only with a blazing-axe, they must find a Porcupine or starve. As these animals grew rare, the men *did* starve. So a new law exists to-day—the thorny rodent is protected under grievous penalties; and none but the starving may molest him. Furthermore, since his chief enemy is also the enemy of his enemies, and has killed off the Fishers, the Spiny race is prospering again.

The Indians have always viewed the Quill-pig as a food supply. Hearne says: "The flesh of the Porcupine is very delicious, and so much esteemed by the Indians that they think it the greatest luxury that their country affords."[58]

As we have already seen, the farmers as well as the hunters in the Rimouski region count, or used to count, on the Porcupine as a staple in their winter diet. Allan Brooks describes the flesh as "sweet and wholesome";[59] and discriminating testimony is offered by William S. Brown, of Alturas, Calif. He says:[60] "I have eaten Porcupine meat on several occasions during the past summer, and found it to be quite palatable. Only for the fact that the meat is coarser in texture, one could imagine he was eating beef—provided, of course, that the Porcupine is young. An old Porcupine is the toughest chewing imaginable." In this we see his use to man to-day.

But in bygone days, also, the Porcupine cut a large figure in the lives of our red brethren. George P. Belden says:[61] "The Crow Indians are the only ones who make combs. They are very simple, and consist of a Hedgehog's

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[58] Journey, p. 381.

[59] Western Porcupine, p. 343.

[60] Cal. F. & G., April, 1921, p. 127.

[61] Belden, The White Chief, 1872, p. 122.

tail, the bristles serving as teeth. When the Hog is killed, the tail is skinned off the bone, and a wooden handle inserted. When dry, it is ready for use, and is by no means a bad substitute for the bone or horn comb we use. A Hedgehog comb is an indispensable article to every Indian girl, as it enables her to keep her long black hair in order."

A still more æsthetic service was rendered by the Quill-pig. The quills—always the quills—were sought after by the Indian women for their fancy work. They were ready-made laces with a ready-made needle at one end. Dyed with roots, berries, barks, and lichens, to a buff, brown, black, red, green, and yellow, or left their natural white, they proved excellent material for the gorgeous embroidery of coats, moccasins, robes, and canoes. These things are famous now as the Red-man's art—an art that we believe was far too true to die; and yet will wield its influence in our modern world, even though it was the savage outcome of a savage's idea, expressed in the spines of a stupid beast, stained in dyes of the plants that it fed on.

His Way of Life

"Yes, that's something I *can do*," said Woodman Dobson. "I can take you to a Hedgehog. When it comes to Foxes, Coons, or even Deer, it's a gamble, but I can sure show you a Hedgehog." And so we set out from our camp on the Oswegatchie River.

An old camp is always a likely place for these creatures; and our first objective point was up the river, a mile and a half, to an abandoned logging shanty. There were plenty of Porky signs about the place. Every piece of wood that had been tainted with salt or grease was deeply gnawed; doubtless, the spiny ones found something here to fill a long-felt want. But not a Porky was to be seen. We tramped off through the woods, and after an hour came back. Dobson was ahead, and as he entered the tumbledown kitchen, shouted: "There he is! Look out, now, or he'll dodge into a hole!"

I hurried forward to see the Porcupine in a little wall-cupboard, where he had been enjoying the greasy, unsucculent shelf. But he had no desire for our acquaintance, and began to scramble down. Snatching a plank to serve as door, the guide shut him into this cupboard. I tore the whole box from its fastenings, and we carried it into the sunlight.

The activity of that spiny creature, and the energy and wrath with which he ground his teeth, were somewhat in contrast with the slow, logy Porcupines I used to know in Canada; and to prevent his escape, we had to slip a wire noose over one hind foot.

First, I examined him closely, and found that the summer moult was so

complete that his upper rear parts were naked except for the quills. These, when raised, radiated from the small of the back, or where that ought to be; in this case, it looked more like the broad of the back.

When tapped on the head or front parts, he tried to turn around; if touched on the hind parts, the tail flew up, or to one side, and left, in the offending stick or boot, a number of quills.

At length he broke the wire, and made off. I ran in front of him, whereupon he turned his back and came on, switching his tail viciously. I held up my foot; he struck the sole of my boot, and left half a dozen quills in it.

We now managed to get another noose on his hind foot, but the moment the leg was pulled straight, he switched that foot full of quills. Here was a quandary. Having made the necessary photographs, we had no right to let the Quill-pig go with his leg full of quills; and so, with much trouble and some danger—for Dobson got a couple of quills in his hand—we freed the Quiller from his own darts, and set him at liberty.

During this affair, that Porcupine lost not less than 150 of the poisoned daggers. It makes one wonder whether, in a series of encounters, he may not run short of ammunition.

All attempts to make this one climb a tree, or roll up like a ball, were failures.

The next day of our search, we passed through a grove of aspens. On the ground was the unmistakable after-evidence of a Porky feast, and I found the feaster dozing in a crotch some ten feet up. A deft push with a pole brought down the over-secure one; and he proceeded to perform for us, making first for a root under which he stuck his head. He defied us with fierce and rotary sweeps of his tail. A noose was slipped over a hind foot so we could hale him into full daylight, and again our prisoner lashed his own foot full of poisoned daggers. As before, we could not make him "ball." Then, as in duty bound, we held him under forked sticks, and removed the spears from his foot before letting him go.

He ran out on a log that was in the water; when I followed, he *retreated toward me* with threatening tail. Then at length he took to the water, and swam slowly, splashily, to the other side, some 50 yards away.

Yet again, I tried to photograph the Porky in the Adirondacks, at Loon Lake, in Aug., 1909. A native showed me the resort of a "Hedgehog." A load of barrels had been carried into the woods, with water to fight a forest fire. They had been left there; and, being pork barrels, attracted the Porcupine, who came and gnawed whenever he felt like having a chew. I went alone every day for five days, without seeing anything but a few fresh signs.

LIFE LXXXIX—THE MUSKRAT

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Muskrat, Mushrat, Musquash, Musk-beaver, Ondatra, or Mudcat

Ondatra zibethica (Linnæus)

(*Ondatra*, the Indian name; L. *zibethica*, adapted from the root of "Zibet" or "Civet," the Musk-cat of the Old World, applied to the Muskrat on account of its odour)

[*Castor*] *zibethicus* Linnæus, 1766, Syst. Nat., XII, I, p. 79.
[*Ondatra*] *zibethicus* Link, 1795, Beyträge z. Naturgesch., I, Pt. 2, p. 76.

Type Locality—Eastern Canada, i. e., Quebec

French Canadian, *l'Ondatra*, or *le Rat musqué*.
Cree, *Was-usk'*, *Wah-chusk'*, or *Wat-susk'*.
Sauteaux, *Wah-sesk'*.
Ojibway, *Wah-jusk'*.
Chipewyan, *Dthen*.
Yankton Sioux, *Tsink-pay*.
Ogallala Sioux, *Sink-pay-lah*.

The genus *Ondatra* (Link, 1795) comprises animals which, in anatomy, are simply huge Meadow-mice, with naked tails flattened on the sides. The Muskrat is the type of the genus.

The teeth are as in *Microtus*, i.e.:

$$\text{Inc. } \frac{1-1}{1-1}; \text{ mol. } \frac{3-3}{3-3} = 16$$

When seen alive, its size, flat naked tail, aquatic habits, and the dark crown with buffy cheeks, will identify it.

In addition to the generic characters, the Muskrat has:

Size. Length, 21 in. (532 mm.); tail, 10 in. (254 mm.); hind foot, $3\frac{1}{2}$ in. (89 mm.).

Weight. Of 8 Muskrats, captured at Carberry in the fall of 1886, the largest, a male, weighed 2 lbs. 4 ox. The smallest, also a male, weighed 1 lb. $5\frac{3}{4}$ oz. A large female weighed 2 lbs. 3 oz. The average of 6 males was 1 lb. 10 oz.

Colour. In general, above, chestnut brown, darkest on the crown and back, becoming pale and gray on the belly and cheeks, and nearly white on the chin and throat and inner side of legs; the feet are covered with close, hard, shiny hair of silvery brown.

Freaks of colour are often seen. Melanistic, or black-coated, Muskrats are not rare; they bring a much higher price than the normal brown. White freaks or albinisms are occasionally met with; they are of no commercial value.

Races

The following forms are recognized:

zibethica Linn., the typical form. T. l., Quebec.

pallida Mearns, a smaller, paler race, without overlying black hairs. T. l., Fort Verde, Ariz.

aquilonia Bangs, smaller than the type; blacker and with smaller hind foot. T. l., Rigolet, Hamilton Inlet, Labrador.

ripensis Bailey, a smaller race; pale, with white spot over each nostril, and a dusky chin-stripe. Size of *pallida*, with shorter tail, and darker colour. T. l., Eddy, Eddy Co., N. M.

alba Sabine, a small race; paler than the type, with shorter tail and foot, and with small molars. T. l., Cumberland House, Sask.

spatulata Osgood, a small, dark race, with spatula-shaped nasals. T. l., Lake Marsh, Yukon, Canada.

zalopha Hollister, a small form with short tail, small hind foot; redder than *spatulata*. T. l., Becharof Lake, Alaska Pen., Alaska.

osoyoosensis Lord, like *spatulata*, but larger and darker; with much larger teeth. T. l., Lake Osoyoos, B. C.

occipitalis Elliot, much like *osoyoosensis*, but paler or more reddish. T. l., Florence, Lane Co., Ore.

mergens Hollister, large and pale; much paler than *osoyoosensis;* larger and darker than *pallida*. T. l., Fallon, Churchill Co., Nev.

cinnamomina Hollister, smaller than *zibethica* or *osoyoosensis;* pale and reddish; teeth and skull small. T. l., Wakeeney, Trego Co., Kans.

macrodon Merriam, like *zibethica*, but much darker and larger; almost black; teeth much larger. T. l., Lake Drummond, Dismal Swamp, Va.

obscura Bangs, smaller than *zibethica*, darker above and less red below. T. l., Codroy, Newfoundland.

rivalicia Bangs, smaller than the type; duller and darker. T. l., Burbridge, Plaquemines Parish, La.

The last two, being completely isolated, are by some considered separate species.

Range

Excepting the Gray-wolf and the Red-fox, there is no North American animal on this list that has so wide a range as the Muskrat. From Altantic to Pacific, from the Gulf of Mexico to the Arctic Ocean (with one or two ever-diminishing blank areas inside this vast and comprehensive realm), it is found in abundance.

Like all successful species, it is extending its range. In California, we learn from Donald R. Dickey, of Pasadena, that the species has appeared in the San Joaquin Valley. A specimen was recently taken on the west shore of Buena Vista Lake, Kern Co.; and seems referable to the form *mergens*.[1]

Continual extensions into all the arid regions may be looked for, as irrigation opens the way. Furthermore, man is responsible for deliberate colonizations of this species of boundless possibilities.

In the *Canadian Field Naturalist* for Sept., 1925 (p. 151), are given details of the recent successful introduction of the Muskrat into Vancouver Island. The species is not indigenous on the island, but has thriven from the beginning. M. B. Jackson, chairman of the Game Conservation Board of British Columbia, has the matter in hand.

The most unlooked-for result, however, is the spread of the Muskrat in Europe; for it is contrary to all precedent for an American species to succeed in Eurasia.[2]

The main facts are as follows:

Muskrats in Central Europe

"In 1906, Princess Colloredo-Mannsfeld imported four pairs of Muskrats [*Ondatra zibethica*] from America; and turned them loose in Dobrisch, an estate southwest of Prague, Bohemia. These animals subsequently increased in such numbers that, at present, they have spread all over Bohemia, into Upper and Lower Austria and Moravia, and also into Bavaria and Saxony, following the watercourses.

[1] Journ. Mamm., Feb., 1923, p. 56.

[2] See my paper on "The Evolutionary Force of a Wide Range," Journ. Mamm., Aug., 1922, pp. 167–69.

"The Muskrats have shown themselves to be very injurious, as they construct their burrows in the dams and embankments of the rivers and ponds; and thus, by undermining the banks, they endanger the whole system of waterways, subjecting the surrounding fields to the danger of floods.

"Very strict regulations have been issued, therefore, in all the countries invaded by the Muskrat, to curtail its further spread; and it is generally forbidden under heavy fines, to maintain the animals, breed them, or turn them loose. All persons directly or indirectly interested, are required to report every appearance of Muskrats to the authorities. Owing to his secretive habits of life, the Muskrat often succeeds in remaining unnoticed for a considerable period in his new haunts."[3]

Home Range

It is a common saying and ancient wisdom that without travel, one's mind is not expanded. The inference is hard on the Muskrat; and yet, regrettable to be admitted, that inference is right.

The home locality of each individual Muskrat is less than 200 yards across. He will live and thrive and be happy in a little pondy marsh even smaller; and never wish to leave it until it dries up. This gives us some gauge on the breadth of his ideas and the development of his poor little mind.

Near Carberry, is an isolated pond only 50 feet across, that has long been the sufficient home of at least one pair of these animals.

On my land in Connecticut is a lake with 2 Muskrat families at points 200 yards apart. When one family was killed, no other Rats were seen in that part of the lake, till new tenants came. All evidence went to show that these Muskrats did not go more than 100 yards from home, and rarely that.

At another point, is a pond about 50 yards long and 10 yards wide. A pair has nested in one end; and although seen daily, they are never observed at the other end.

In an Iowa prairie-pond about 40 yards by 60, surrounded by dry, open country, I saw 8 good-sized rat-houses; one of them seemed to be double, it was so large. In a pond about 30 by 40 yards, I saw 3 large rat-houses. In another isolated round pond, 10 yards across and quite alone in a dry region, was one large rat-house. This was on Nov. 28, 1905.

Near Washington, Minn., Nov. 30, 1905, I saw 15 large rat-houses and some smaller beginnings in a pond but 30 by 100 yards. The number of houses to the acre seemed to increase as we went northward

On the 12-acre lake on my homeland in Connecticut, in the fall of 1924,

[3] Theodor G. Ahrens, Journ. Mamm., Nov., 1921, p. 236.

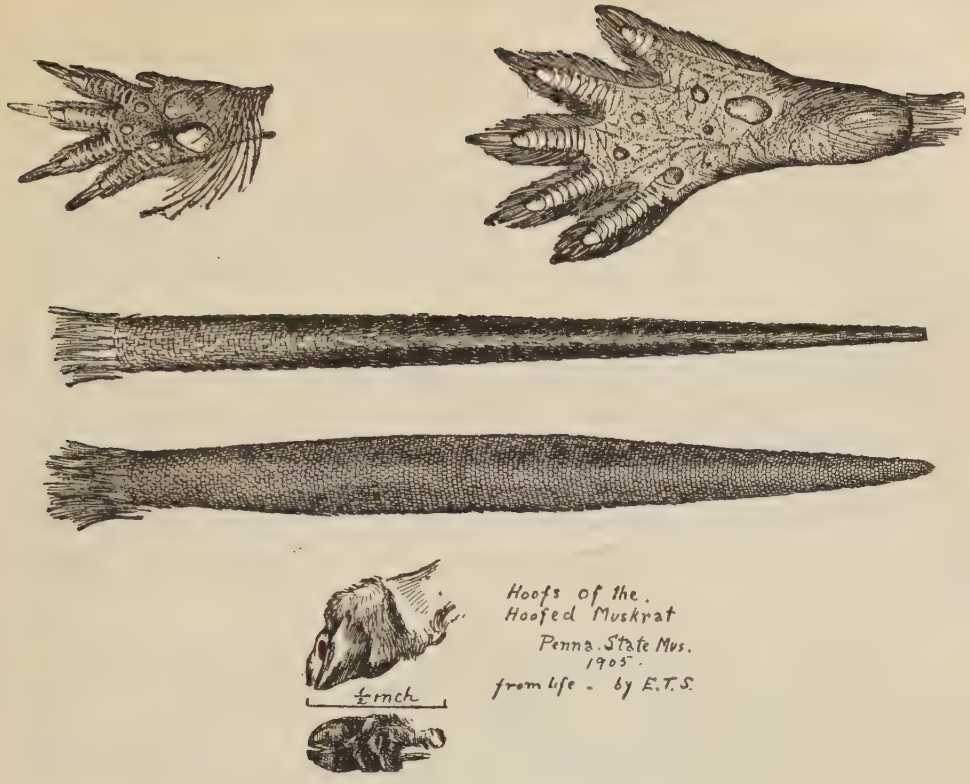

PLATE LXX.—DETAILS OF MUSKRAT ANATOMY, ETC.

The upper figures represent fore foot, hind foot, and two sides of the tail. Cuts from Mearns's *Mammals of the Mexican Boundary*, supplied by the U. S. National Museum

Central figure shows the hoof of the freak Muskrat collected by Prof. H. A. Surface, of Harrisburg, Pa. The lowest figure shows the simplest style of Muskrat den. Noted at Cos Cob, Conn., 1906

I counted 23 rat-houses; besides which the high banks all around afforded desirable denning places for at least as many more Rats.

Haunts and Migration

There is an old Indian legend which tells that the Muskrat rendered great service to Nanabojou during the Flood. So the Sun-god said: "You may have any part of the country to live in that you please." The Muskrat took the deep blue lakes.

But next day, he came back, and said: "I made a mistake; I want the grassy banks where there is something green to eat." These were given him.

The next day, he was back to say that he was again mistaken, as the banks offered no chance to swim, and he wanted the deep water again.

Nanabojou replied: "One day you want land; the next day, water. You don't know your own mind, so I will decide. Henceforth, you shall live in the Between-land of the marsh—neither land nor water—where there is long green grass to eat, and water deep enough to swim in." And so it has been ever since.

Wherever, on this vast continent, there is slow water with rushes or weeds, we find their child, the Muskrat. And far from these, he is never found, except when seeking a new home.

This home-seeker may have been crowded out by overpopulation or by man; but most often by the drying up of his native pond.

In September, or sometimes later, an erratic migration takes place. The Muskrats then travel overland for a considerable distance—as far as a mile or two from the water; so that they are to be found in various odd places. I have seen them in outhouses, in wheatfields, and on the open prairie at such times.

"In late March," says A. W. Anthony of San Diego, "I once met a Muskrat on a sage-grown mesa, a full mile from the nearest stream, and 15 miles from the nearest water toward which he was journeying."[4]

When thus discovered, they commonly show fight, even going out of their way to attack the disturber of their peace.

Shifting Populations

Like all fur-bearers—probably all animals—the population of Muskrats is ceaselessly changing. Bad weather, floods, droughts, epidemics, etc., affect their aggregate numbers.

[4] Journ. Mamm., Feb., 1923, p. 60.

Thus, in 1907, when in the Slave River country, I met William Hays, an engineer, who told me that in 1900, the Muskrats were extremely abundant on Willow River, a branch of the Mackenzie, 18 miles below Providence. A man could stand in one place during the evening, and shoot 20 Rats with a 22 rifle in an hour. That fall, after the ice came, the river rose 4 feet, and all the Rats were drowned or driven out—mostly drowned. Next year, there were "no Rats; they have been scarce ever since; but are slowly coming up again."

J. Dewey Soper writes: "It is estimated that between 1,000 and 2,000 Muskrats inhabited the dried-up lake west of Islay [Alta.], in the pre-settlement days. This has an area of approximately one and a half square miles. Two trappers, operating between Edmonton and Vermilion, via the Vermilion lakes, in 1908, took for fall and spring 3,900 Muskrat skins. From Manville to Vermilion, on the Vermilion River, a distance of about 50 miles, one party in the old days took 2,500 skins, and I understand this was for the fall only. To-day, the majority of these places are nearly destitute."[5]

It is morally certain that Muskrats were unknown in the Imperial Valley, Calif., until some 20 years ago, when irrigation was developed. Now, what a change! Joseph Dixon, discussing the abundance of the species in that Valley to-day, sets the number as high as 200 per mile along some of the banks; and adds: "In three months, W. W. Morrison and assistant, caught 1,738 Muskrats. From the known numbers of trappers and their catch, it is conservatively estimated that 25,000 Muskrat pelts were shipped out of the Imperial Valley during the trapping season of 1919–20. It is further believed that the catch (25,000) equalled one half the total population of Muskrats."[6]

Numbers

In the marshy parts of Manitoba, I have often seen 100 Muskrat families in 50 acres of marsh; there may easily have been 10 Rats to the acre.

More exact light as to rate of population, is found in the following: In Delaware, Gen. Coleman Dupont has a marsh of 1,000 acres, in which they formerly trapped 4,000 Muskrats per annum. This, however, proved too heavy a drain. Now they take only 2,000 a year, which the Muskrat population stands quite well; implying, I take it, a stock of 10,000 Rats, or 10 to the acre.

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[5] Can. Field Nat., Sept., 1921, p. 108.

[6] Journ. Mamm., Aug., 1922, p. 141.

Dr. Charles E. Johnson says: "In certain protected marsh areas, which I saw in this State [N. Y.,] I am quite certain that an estimate of as many as 10 breeding pairs to the acre, is no exaggeration."[7]

In Minnesota, with its area of about 80,000 square miles, 3,000,000 Muskrats are taken annually.[8]

In Louisiana, according to F. G. G., the 45,000 square miles yielded in 1909, some 500,000 Muskrats.[9]

In Delaware, according to the Smyrna *Times*, "the largest trapper on Bombay Hook Island is Jim Hoffecker, who has delivered 3,200 hides from his marsh."[10]

These, however, are local observations and high records. The whole of the range has been under contribution for more than 150 years, because its fur has always had a place in the markets. As early as 1822, the Hudson's Bay Company exported 150,000 Muskrat skins annually. Since then, the numbers have steadily increased; and 3,466,429 were marketed in London during 1905.

The ever-growing demand for Muskrat fur is shown in the sales records for the last 150 years. Prof. David E. Lantz[11] has found that "from 1763 to 1800 (38 years), the total number of Muskrat skins imported and sold in that [London] market was 2,831,453, an average of less than 75,000 yearly. During the 50 years from 1801 to 1850, the total was 20,571,428, or an average of 411,000 yearly. From 1851 to 1890, inclusive, the importations were 99,893,591, a yearly average of 2,500,000.

"The average London sales in recent years have been over 4,000,000 per annum, and the entire output of skins for 1900 was 5,285,000. . . .[12] The total output of 1905 . . . was over 7,000,000."

To this, Dr. Charles E. Johnson adds: "In 1919, according to John F. Mallon, Actuary, Fur Dressers' and Fur Dyers' Assoc., Inc. (in a statement dated Jan. 14, 1920), the total number of dressed Muskrat skins for the entire country was 8,643,422."[13]

According to the official published reports, the total number of Muskrat skins taken in Canada alone during the seasons 1919–20 to 1923–24, was as follows: 2,377,424; 2,915,481; 3,060,526; 3,846,161; 2,985,395. The bulk,

[7] Muskrat in N. Y., p. 312.

[8] Fins, Feathers, and Fur, Dec., 1916, quoted in Cal. F. & G., July, 1917, p. 132.

[9] Forest & Stream, May 22, 1909, p. 815.

[10] As above, May 21, 1910, p. 812.

[11] The Muskrat, pp. 24–26.

[12] Rept. U. S. Com. Fish & Fisheries for 1902, pub. 1904, p. 285.

[13] Muskrat in N. Y., p. 207.

apparently, came from the United States, where less favourable Muskrat range is offset by the much larger number of trappers.

Add to the above total, about 1,300,000 killed for flesh, and not marketed. This would give a grand total of 10,000,000 Muskrats per annum; and, as Prof. Lantz says: "It is probable that, with adequate protection in the breeding season, from 10,000,000 to 12,000,000 pelts can be taken annually in North America, without depleting the supply."[14]

Assuming, as for other fur-bearers, 20 per cent. to be the drain that the species can stand, we have a Muskrat population of 50,000,000. I can easily believe it to be true.

The Fur

The Musquash fur is of good quality, warm, dense, and waterproof; it is on a strong skin which makes a durable leather. So that, even as Muskrat, it has always commanded a steady market. But we have lived to see great changes. The neo-fur-men have developed many and mysterious methods. Out of commonplace Muskrat, they can, by their magic, conjure up "Plucked Beaver," "Wallaby," "Velvet Coney," "Moleskin," "Sealskin," "Otter." To so many new and rare products does the innocent Ratskin lend itself, that its value has gone up twenty-fold.

These new appreciations are sufficiently reflected in the market ratings. During my young days in Western Manitoba (the early '80's) we used to get 5 cents per skin, and then had to take it out in trade. For example, 3 Muskrat skins, if prime, would buy a pound of sugar; 15 would buy a pound of tea; and 20 would buy a pound of tobacco. As late as March 26, 1904, the Winnipeg fur market quoted prime winter Muskrats, 3 cents to 12 cents; prime spring, 6 cents to 20 cents.

The average values per skin on the Canada catch for the years 1919 to 1924 were: $2.54; $1.24; $1.54; $1.32; $1.15. But during the great fur boom of 1919–20, choice skins brought as high as $5.00 and $6.00.

According to the latest official returns from Canada (and probably for all America), the aggregate catch of Muskrat pelts exceeds the total number of all other fur-bearers; and the value of the catch is, by far, the greatest on the list.

To put it in figures: For 1923–24, the total Canadian catch of Muskrats was 3,440,363; the total catch of Beaver, 169,172; the total catch of all species, 4,207,593. The total value of the Muskrat catch was $2,985,395; of the Beaver catch, $2,542,992; the total value of all furs taken in Canada

[14] The Muskrat as Fur-bearer, p. 12.

that season was $15,643,817. That is, the Muskrat made about ⅘ of the number, and ⅛ of the values; the Beaver coming second in value.

In view of these facts, then, it is not too much to claim that the Muskrat is the most important fur-bearer in America.

The Flesh

The flesh of this animal is eaten at all times by the Indians. In the fall and the winter, it is not unpalatable—indeed, it somewhat resembles duck; but in the spring, it is so impregnated with musk as to be repellent to most persons.

When Muskrats are to be eaten, they are commonly shot; but only the trap and the spear are used when they are taken for fur.

The Biological Survey has offered a Bulletin[15] on "The Muskrat as a Fur-bearer," and as a food supply. In this, full directions are given for successful cooking of the Muskrat flesh—by frying, roasting, and stewing; concluding with a remark: "The slightly gamey flavour of Muskrats prepared by the above recipes, is liked by most persons. Should it be objectionable, it may be overcome by soaking the meat overnight in salt water."[16]

But for the unfortunate stigma conveyed by the word "Rat," it would long ago have been listed among the delicacies of the game list. In my opinion, well-cooked Muskrat is preferable to ordinary canvasback duck; that is, canvasback without the embellishments of the latest and most refined cuisine.

In the markets of Philadelphia, Wilmington, and of Baltimore the gastronomic capital of America, the carcasses of Muskrats are sold as "Marsh Rabbits."

How to Trap the Muskrat

I decline to make any statement.

A Freak Foot

The following is a remarkable case: During the fall of 1905, a trapper, Nelson Crane, living on the Oquago Creek, an affluent of the Delaware River, Pennsylvania, was surprised to see, along the margin of the river, the unmistakable track of a hoofed animal whose feet were smaller than those of the smallest African Gazelle. Each track was less than the tip of a little finger; the stride was two inches, the straddle a little over an inch. At many

[15] No. 869, Sept., 1917, see References.

[16] P. 11.

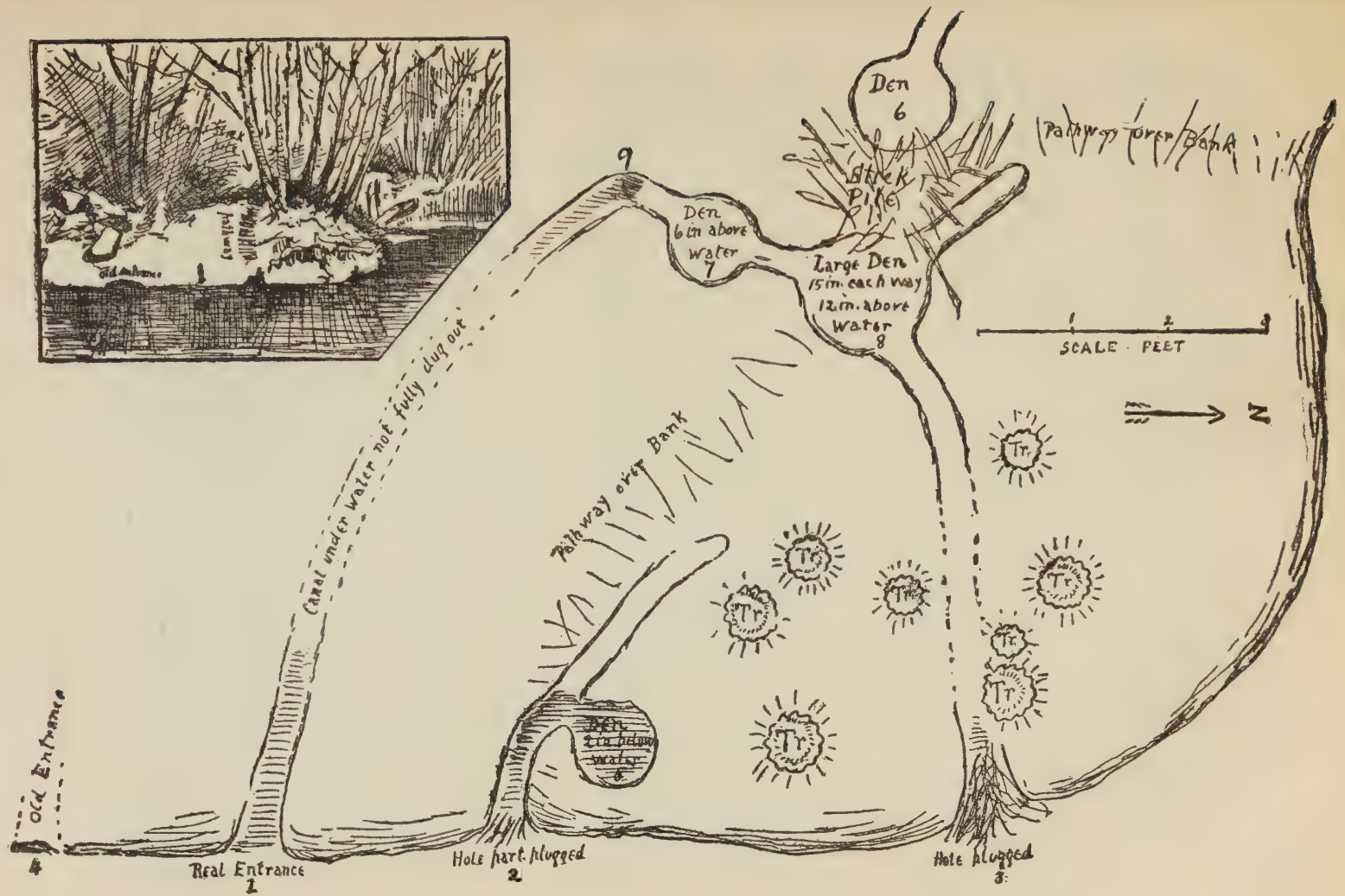


PLATE LXXI.—SKETCH AND PLAN OF A MUSKRAT DEN AT COS COB, CONN., JULY, 1905

places, very clear impressions were seen; and left not the slightest question of its being a tiny, hoofed quadruped of unknown species.

One day, on going to a trap set for Mink, Crane found the undoubted track of the "Pigmy Deer"; and in the trap, to his amazement, one of the legs of the animal with the hoofs. There was just enough of the leg to show that it was nothing more than an abnormal Muskrat, the central toes of each foot having enormously developed short claws which covered the point of the toe, and were indeed hoofs. The trapper sent the foot to the Harrisburg State Museum. Through the kindness of the curator, Prof. H. A. Surface, I have been able to examine and make the accompanying drawing of this curiosity. (Plate LXX, p. 573.)

The animal itself has never been seen.

Speed and Powers

On the land, the Muskrat is slow; a man can easily catch one. Indeed, I never knew one try to escape, if found on land. He knows that here his case is desperate; so, instead of running away, he bravely turns to fight.

But the water is his proper element; he swims and dives almost like an Otter. I have often run along on the thin, clear ice, over a Muskrat that was swimming just below, and found he was going, for the spurt, at which I should call 3 miles an hour. But observations made while walking parallel with a swimming Muskrat, lead me to say that his ordinary rate is not above a mile an hour.

In swimming, the hind feet principally are used, but the tail assists; although it is quite common to see a Muskrat swim with his tail curved clear out of the water.

Much of the Muskrat's hold on life is derived from his diving power, for he can outswim and outdive a Mink. He can swim fifty yards without coming up for breath.

E. P. Robinson, the Packerville, Conn., correspondent of *Forest & Stream*, writes concerning a naturalist friend: "While looking carefully for suckers, he saw a Muskrat at the bottom, apparently eating something. He watched, and presently the Rat turned his nose upward, and expelled the air from his lungs in small bubbles, which rose to the ice through 2 or 3 feet of water, and formed a large bubble, which the Rat came to and re-breathed, and proceeded to resume his feeding. He watched him repeat the performance several times, always letting the air rise through the water."[17]

[17] Forest & Stream, April 22, 1911, p. 612.

In one particular activity, the Muskrat is at the bottom of the scale—he cannot climb a tree. He cannot climb anything but a low mound or bank. He is no better off than a Mole or tortoise in this respect. A 2-foot fence, unless he can go under or around, is an impassable barrier to him.

Play-game

Every animal treated in these Lives has a song, a dance, and a play-game. This is a perfectly safe, though unproved statement. I expect, in time, an affirmative, detailed answer to each and every assertion concerning each and every animal in the above connection.

The Muskrat is not an intellectual wonder; one might even be justified in applying adjectives that sounded harsh, when speaking of his wits. Yet I was not surprised to find the following, also from the pen of the Packerville naturalist. He was cultivating the acquaintance of certain Muskrats, and doing it by the well-known trick of softly talking and singing to them—"making medicine" with his mouth, as the Indian would say. He continues:

"On two or three occasions, after we became on friendly terms, one of the young ones, possibly to repay me for the music, gave an acrobatic performance which was entirely new to me. After lying on the water quite still for a time, he would begin to sink lower, and turn around and around like a Dog chasing his tail, gradually sinking lower and lower, and ending the feat wholly under the surface, which seemed greatly agitated."[18]

Food

By all the rules of dentition, the Muskrat should be strictly a vegetarian. As far as is convenient and agreeable, the Beaver's little brother lives up to this understanding, and the food of the species is chiefly vegetable matter. The bleached ends of long reeds, lilies, stalks, and roots of flags are staples; but nearly every green thing in the marsh is a bag of vitamines for him. He is impelled to one or other kind of food by the urge of his body, which, in the blissful safety of its ignorance, demands this or that peculiar herb to be stressed, to the forefending thereby of a thousand ailments, of which he never has a clear consciousness, much less a name. (Humans, take a hint from this, and cultivate natural appetites.)

Sir John Richardson, writing at Churchill River (103° W. long.), in 1848, says[19] of one Muskrat food: "The *Acorus calamus* is another of the indigenous plants that enter into the native pharmacopœia; and is used as a

[18] Forest & Stream, April 22, 1911, p. 612.

[19] Arctic Searching Expedition, 1851, I, pp. 82–83.

remedy in colic. About the size of a small pea of the root, dried before the fire or in the sun, is a dose for an adult; and the pain is said to be removed soon after it is masticated and swallowed. When administered to children, the root is rasped, and the filings swallowed in a glass of water, or of weak tea with sugar. A drop of the juice of the recent root is dropped into inflamed eyes, and the remedy is said to be an effectual, though a painful one. I have never seen it tried. The Cree name for the plant is *watchuske mitsu in* or 'that which the Muskrat eats.'"

There is not the least doubt, furthermore, that the Muskrat will eat clams, fish, insects, and even young birds, when it can catch them *in* the water.

As a Clam-eater

There is a backwoods saying: "A pile of empty clam-shells by a hole means a fur cap inside"; and there is much evidence that clams are a favourite food of the Muskrat. He is adroit in his ways of getting at the clam. He can, indeed, cut the hinge and force it open; but, when not pressed for time, he follows a simpler plan. He lets the clam die on the dry bank; then it opens itself.

J. Alden Loring, in a detailed article, emphasizes the clamophagy of the Muskrat. "Along the banks of the beautiful Susquehanna River," he says, "I have seen bushels of clam-shells heaped under a stone, a log, or the roots of a tree, by Muskrats, after they had feasted on the contents of the shells.

"In one place, while canoeing down the river from Cooperstown, I passed a strip about 3 miles long, that was particularly thick with clam-shells. While gliding silently along down to shore, I surprised a Muskrat on the bank. After it had rushed into the water, I landed and trailed it in the soft mud to a spot a few feet from the shore, where it had stuck a fresh clam in the mud to be opened by the sun.

"This accounts for the large number of shells that are found unbroken in the heaps."[20]

Similar testimony is received from many other observers. R. E. Coker, of the U. S. Bureau of Fisheries, says: "The most important element of the winter food of the Muskrat . . . is the fresh water mussels or Unionidæ. . . . Sept. 24, 1907, one of these piles on Long Point was examined. It was offshore several feet, and in water 18 inches deep. About one half of the shells were examined critically, and counted. There were 532 shells representing four species.

"During the fall, these operations are probably confined to mussels

[20] Recreation, Nov., 1900, p. 383.

which they find in shallow water near shore. In winter, however, when ice-cracks form, and extend well across the lake, the Muskrats go far out on the ice, dive through the cracks, and bring up mussels which they eat, sitting on the ice. At such times, they get mussels at considerable distances from shore. In the first days of Jan., 1905, a broad crack formed in the ice from Long Point to the Norris boathouse. On Jan. 4, a Muskrat was seen at the edge of this crack about 1,000 feet from shore, eating mussels. It would dive through the crack; and, after a little while, reappear with a mussel. Sometimes, it dived five and six times before securing one. It would then sit up on its haunches, holding the mussel in its paws; and, by much clawing and chewing, finally succeed in opening the shell, and removing the meat, which it usually licked out quite clean. In some cases, the Muskrat failed to get the shell open."[21]

From Winnipeg, George H. Measham writes me: "Whether clams are part of their customary bill of fare during the winter, I do not know; but they have regular feasts of them in the spring, and consume astonishing numbers of them. The Muskrat will pick on a suitable place on the bank of the stream for his dining table, often a broad, flat stone; and then proceed to dig out of the river bottom a fine, fat clam. He carries it to this chosen spot, speedily opens the shell, and devours the contents. Opening clams is not easy, unless you know how; and the Rat knows how. He bites through the leathery ligament that joins the shells together at the back; this done, the clam is his meat."

Fish and Flesh

The steps are easy from clams to other animal food found in water. The testimony is in line:

R. E. Coker in the article already cited, says: "Muskrats also feed to a considerable extent on fish, crawfish, and frogs. We have, on more than one occasion, found partly devoured fish at their feeding stations, and remains of fish, frogs, and crustaceans in their kitchen-middens. We have never seen a Muskrat catch a live fish, but have no doubt they do so. They certainly pick up freshly dead fish which they chance to find."

To this, a still more sporty touch is given by Edward R. Warren, the Colorado naturalist. He says he has seen a Muskrat "chase and catch a water-dog or lizard. Four years ago, a friend and I were driving by Nichols Lake, near this place; and we noticed some animal swimming under water, chasing another animal. I pulled up the Horse at the edge of the lake. The water was calm, and the sun shining, so we could see everything clearly.

[21] Forest & Stream, April 1, 1911, p. 493.

My first thought was that it was a Mink trying to catch a trout; but I soon saw what the pursued was. The water-dog twisted and turned quickly, but his enemy was as quick as he. Finally, when the two were about 3 feet apart, and 25 or 30 feet from shore, the pursuer made a sudden dash, caught the water-dog, and rose to the surface. Then I saw the pursuer was a Muskrat. It swam partly out of the water, so I could identify it beyond doubt. The Rat swam off with its prey."[22]

Testimony of this kind could be piled up in volumes; but an interesting new turn is given to it in the following by Avon Woods. He and a friend were out ducking in Nov., 1899. They noticed the splashing of Muskrats. His friend said: "Watch me call out that Rat." Woods proceeds:

"My friend was an adept at imitating the quack of a duck with his own voice. When he reached a place that suited him, he remained quiet for some minutes. Then he raised one foot to the surface, and splashed the water gently, uttering a most natural imitation of a female mallard, which reverberated over the water in the deathlike stillness.

"This seemed to me a strange way of coaxing out a Muskrat; and I thought my friend was jesting, or had caught sight of a flock of ducks, and was trying to decoy them in. But I was mistaken; for, in less than half a minute, as I watched the water in the reflection of the moon, I saw a fine, large Muskrat swimming directly toward him, turning its head from right to left, as if looking for something. My friend stood perfectly still until the Rat came within 8 or 10 feet of him, when it ran its head squarely into a charge of number 5 shot.

"My friend brought the Rat to shore; and, as he threw him down on the snow, he said, 'This Rat has evidently been in the habit of catching and eating wounded ducks, and perhaps of pulling down those that were not wounded, and drowning them.'"[23]

It is not surprising, then, that wise old-timers like Manly Hardy often use meat baits when trapping the Muskrat. The following is from his record: "We caught a Muskrat in a log trap with meat, quite a way back from the water, and a Rabbit (Hare) in a log trap baited with fish."[24]

Storage

Although not usually credited with storing up food for winter, the Muskrats do so at times. All through the summer, from at least the first

[22] Recreation, Nov., 1900, p. 383.

[23] As above, Dec., 1899, p. 439.

[24] Forest & Stream, May 28, 1910, p. 850.

of June, they may be seen carrying great bundles of green stuff into their dens. If intended for bedding, it seems to show very poor judgment on the part of the Rats; but it ends well, for they commonly eat these piles when they have need of them. This is, indeed, one kind of storage.

The species, however, is known to carry out the idea on a much higher plane, as shown in the following by Dr. Charles A. Eastman:[25] "When our people [Sioux] were gathering the wild rice [in Minnesota], they always watched for another plant that grows in the muddy bottom of lakes and ponds. It is a white bulb about the size of an ordinary onion. This is stored away by the Muskrats in their houses by the waterside, and there is often a bushel or more of the *psinchinchah* to be found within. It seems as if everybody were good to the wild Indian, at least, we thought so then." Evidently, this was the *wapato*, or duck potato, a species of *sagittaria*.

The Muskrat does not usually lay up a supply of food in the sense that the Beaver does; yet the rat-raft and rat-house both are closely connected with the quest of food. In the winter, it is obvious that the house is much eaten away from the inside. While the roof is frozen, this makes no difference; but in the spring, when the frost gives, the top of the enlarged chamber is apt to fall in.

The filling up and digging is now resumed; for in many cases, the rat-house is the home of the young brood; that is, when there are no high banks near by to afford opportunities for burrows.

A Muskrat Silo

A much more complete and satisfactory mode of storage is announced by Thomas D. Carter, of Saskatchewan. He describes the four tunnels, each 8 inches wide and 12 feet long, that branched from the Muskrat's main tunnel in a dry bank; then says of these:

"These tunnels were packed with tender bullrush roots, sedges, mints, young grass, and reeds. The bulk of the store was white and crisp, and very tightly packed. Each of these tunnels was plugged with clay at the junction with the main tunnel, to exclude air. . . .

"The young Muskrats aided the parents by carrying earth from the tunnel, and also in bringing in the food store." [26]

Social Calls and Usage

The Muskrat is more sociable than the Rabbit, but less so than the Beaver. Several will join their efforts to produce the rat-house or lodge; and

[25] Indian Boyhood, 1902, pp. 239-40.

[26] Can. Field Nat., Dec., 1922, p. 176.

they are always careful to announce to each other the discovery of danger by the loud alarm splash, that the uninitiated think could be made by nothing less than a Moose jumping into the water. I have several times heard of Muskrats uniting also to fight some common enemy, but never saw one of these affairs.

Besides the danger splash already noted, this animal can use its voice as a means of signalling. A low squeaking, made by sucking the back of one's hand, gives a passable imitation of the Muskrat's friendly call to its mate, and is sometimes used by the Indians to decoy the swimmer within shot. At times, Muskrats squeal very loudly, and snarl among themselves.

Besides these sounds, the anal glands also serve as a method of communication. They secrete the well-known musky smell; this is left with the dung at the various landing places, and I doubt not answers as a sort of crude news office, or club register, as described in the Gray-Wolf Life (Vol. I, p. 286). Each Rat, on arriving, can tell by the smell, whether or not any of his acquaintances have called there recently.

A Little Brother to the Beaver

The Beaver's little brother has paralleled the Beaver's activities in every department but one—namely, the Muskrat does not make a dam. A home he makes, and canals, jetties, tunnels, rat-rafts, eating huts, food stores, mud or dung-pie signals; but, so far as I know, not the remotest approach to a dam that is meant to hold and deepen the water.

The Bank-den

The bank-den is quite as important as the rat-house; and in regions where marshes or shallow waters are scarce, is the creature's home. Very clear-cut plans are followed in making this.

When the water near the shore is shallow, the Muskrat digs a canal from the deeper water along the bottom. This is like a railway cutting, open at the top until the rise of the ground makes it easier for the Muskrat to take the plunge—that is, to carry the canal on as a tunnel; after which, it ascends obliquely to a chamber above the water level near the surface.

The evolution of this canal is suggested in these notes from my journal. In late May, at Cos Cob, Conn., John Crawford surprised a Muskrat in the small pond while away from its hole in the bank. He stood over the hole; and, though the water was but 6 inches deep at the time, it plunged into the mud and leaves at the bottom; and by tunnelling in that, stirred up such a cloud that it escaped unseen into the hole. This I also saw the next day. I

think its real object in getting into the mud was to swim as deep as possible, but it was at the same time beginning a canal.

The diagram in Plate LXXI (p. 579) represents one of these that I examined at Cos Cob, in July, 1905. It was under a clump of young ash trees, and presents all the usual characteristics of the bank-den. Nos. 2 and 3 were holes at water level. They were plugged up with grass and sticks when exposed by the water lowering. No. 1, the real entrance, was deep under water, and was made later; No. 5 was a den with about 2 inches of water in it; No. 6, a small den not connected with the others; No. 7, a small den at a lower level than the main den; at No. 9 was a plunge hole from the den into deep water. No. 8 was the main den, nearly round, 15 inches each way, smoothed with great labour in gnawing off thick roots. It was very near the surface, and had a ventilator under the stick pile, as also had No. 6. The pathways were evidently made by the Muskrats in carrying up these sticks.

The main den had quantities of green grass and stalks in the corners; among these, jewel-weed was prominent. This was fresh-cut, and may have been either food or bedding—probably both.

This den illustrates the style of all those I have examined on banks. They have one main entrance under water; sometimes other smaller entrances. The tunnel leads up to a commodious den, which is open to the air at one small place, and covered outside with a pile of sticks and grass.

The main features of this agree perfectly with those of the nest made in a rat-house. The stick pile over the roof shows how easily one grades into the other.

There was no dung anywhere in the dens; all was sweet and clean.

Tunnels

Usually the tunnel is merely the approach to the bank-den; but it also furnishes a deep-water escape, as well as a highway in shallow waters that may freeze to the bottom.

Thomas D. Carter, of Saskatchewan, furnishes some interesting observations on the tunnels. In August, a family of 2 old ones and 4 half-grown young Muskrats began in a small pond but 2 feet deep. By September, they had made a trench 107 feet long and about 14 inches wide. It ended in a den that was under a willow, 30 feet from the pond, and which measured 14 inches high and 9 inches wide.

In early October, 4 other tunnels above water line were branched from the main tunnel; these were each about 12 feet long, and 8 inches wide. They were crammed with food in storage, as already noted.[27]

[27] Can. Field Nat., Dec., 1922, p. 176.

The Rat-lodge

The rat-lodge or house is the most obvious announcement of all that there be Muskrats in this place. In Manitoba, where there are very large marshes with low banks, the rat-houses are conspicuous features of the landscape; and important to many species of bird, especially ducks, which find them convenient nesting places.

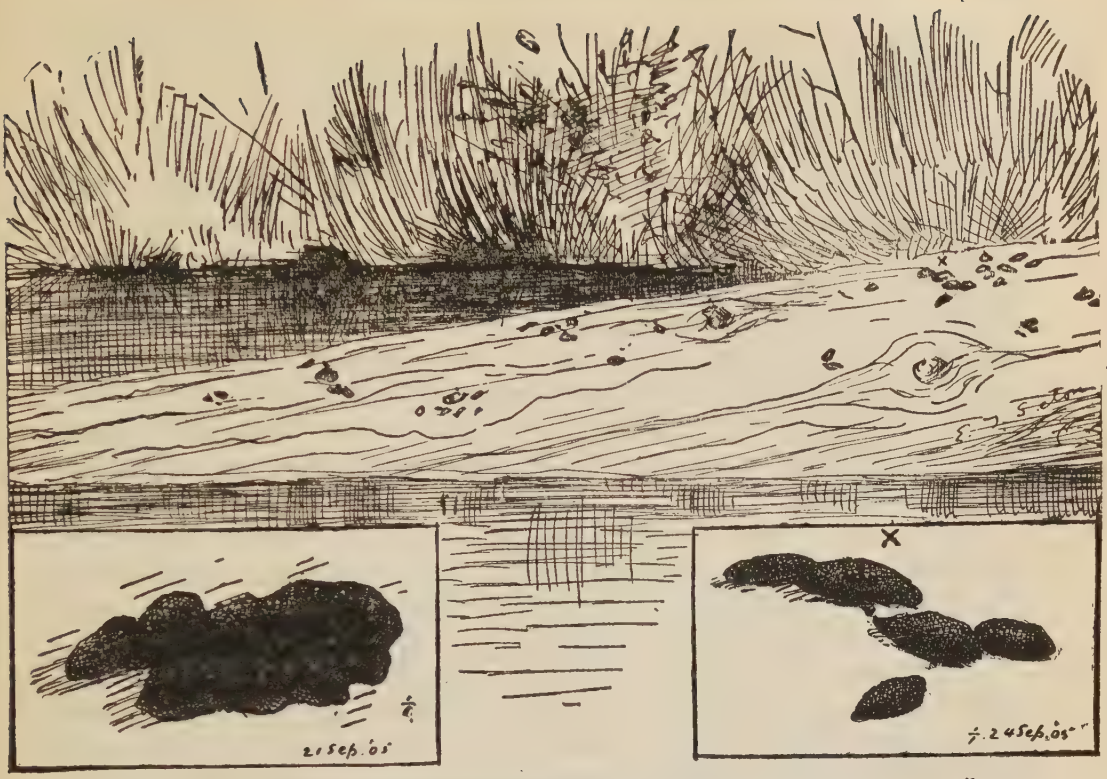
The Little Beaver begins in July to get ready for the winter, either by repairing the old home, or founding a new one. George H. Measham, of Woonona, Man., says he has known a pair to keep the same site for years.

When a new nest is to be made, they select a place in the weeds or rushes, where there is about two feet of water; and begin to drag to one spot the vegetation and mud for 10 feet around. In this way, a little island of rubbish is gradually piled up, and the water around is deepened and cleared of rushes, etc. As the island rises above the water level, less mud and more reeds are used—this is probably unintentional, as the reeds are easier to carry than mud. Now it is made a little wider, and becomes like a low haycock on a small base of mud and trash. As soon as it is a few inches above water, the builder begins to dig a tunnel under the level through the rushes on to the surface of the mud island and into the thin haycock.

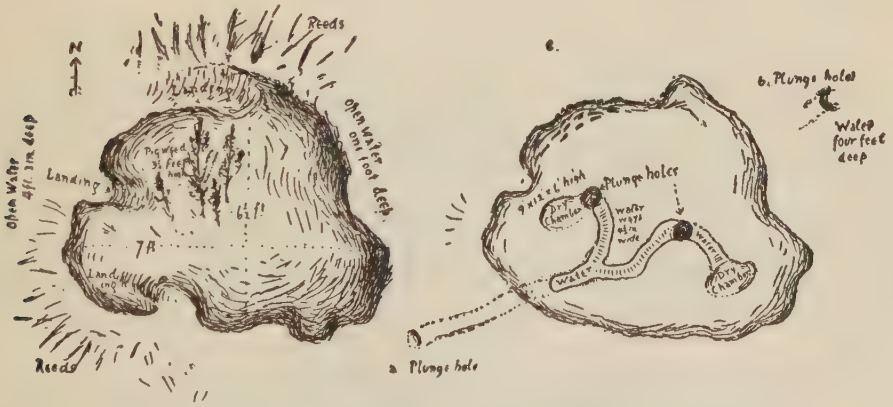
This now answers for a house, although the roof is so open that the Muskrat can see out. But the process of building goes on; each day, a few more bundles of reeds are dragged on to the pile. It grows, until, by August, it is perhaps 3 or 4 feet high; but the mass of stuff piling in, keeps crushing down the roof of the centre chamber and its gallery. The builders offset this by tearing off the encroaching ceiling, as it gets too low. In time, the subsidence ceases, the floor of the chamber is now covered with the reeds shredded in heightening the vault. The chamber is enlarged, additional entrances are made, the channel to each is deepened, and the Muskrat's house, after a slow growth during perhaps four months, is ready for winter.

I cannot say that I have followed one house through all these stages, but I have seen nests so obviously presenting each, that I consider the process demonstrated.

The ordinary house has but one chamber, but I have seen examples with more, doubtless the product of two families uniting their efforts, although each family lives by itself, having separate rooms and doorways. In Sept., 1904, I examined a large rat-house on Lake Winnipegosis, and made the accompanying diagrams (Plate LXXII, p. 589). This house was probably the joint home of two families.



Log that was a favourite landing place and news-depot of the Muskrats on a small stream 40 miles east of Kippewa, Que. With illustrations of their scatology (natural size)



A large rat-house sketched at Lake Winnipegosis in Sept., 1904.
As seen from above, and in plan

PLATE LXXII.—DETAILS OF MUSKRAT HOUSE, AND SCATOLOGY

The lodges are resting places and sleeping places, as well as, in some cases, the nurseries for the young. They are truly the homes of these animals.

The Rat-raft

Each of these large houses is surrounded by a number of rat-rafts which are like outlying fortresses of the great central camp; these are merely floating bunches of reeds, with anchorage of a few growing stalks. Their first purpose seems to be furnishing the members with landing places where they can feed comfortably. But when the ice forms, they answer a new need—they afford breathing places; for the reed raft makes it easy to keep the ice open there, and also conceals the Muskrat that is using the place.

In the winter, if the occupants be frightened out of the big citadel, they will usually be found in a few minutes scattered at the various breathing rat-holes.

In very deep water, we find a type of nest that is both house and raft. Its foundation, instead of being a mud island, is a floating mass of reeds. It answers well for the fall and winter, but usually becomes water-logged and sinks from sight in the spring.

The inborn home feeling that the Muskrat has for its raft—that is, its house beginning—is shown in this incident. During my early days on the Souris Plains (May 9, 1882), I fired at a Muskrat sitting on a large raft. It dived off into the water, but returned to clamber on to the floating reeds. I walked gently near, then waded out to find it was the same Muskrat—stone dead. It had come back to its raft to die.

Eating-huts

A higher development of these outlying posts is thus described by Dr. John Rae:[28] "The house-building habits of the Muskrat, in nearly every part of British North America, are well known; but there is one plan to which it sometimes resorts under certain circumstances, which appears to show great intelligence in enabling it to get its food more readily. The Muskrat, when about to build its house, selects a pond or swamp of good, pure water, on the bottom of which grow the plants which constitute its winter supply of food.

"If the pond or swamp is of considerable extent, and the house a large one containing many Rats, they, when the water begins to freeze in early winter, keep several holes open in the ice in different directions, and at a distance from the house; and build a little hut of mud and weeds (just large

[28] Birds & Mamm., H. B. Co., Linn. Soc. Journ. Zool., XX, Pt. X, 1888, pp. 142–43.

enough to hold one Rat comfortably) over each hole, which—especially when covered with snow—prevents it freezing up. These huts enable the Rats to extend their feeding-ground to all parts of the pond, which could not be reached at all, or with difficulty, from the house if they had to swim home every time with a mouthful of food to eat it. With these little shelters, they are saved a great amount of labour, and are enabled to reach all the food in the pond.

"I remember, when on a snowshoe journey, one of my men went very quietly up to one of these miniature mud-huts, and knocked it over with his axe, disclosing a live Rat with some of the food it had been eating. The practice of building these little eating-huts is by no means common, and does not seem to be resorted to when the pond is of moderate dimensions, and all parts of it can be reached from the house without difficulty."

Jetties

Muskrats frequently make jetties or landing places. These are little banks of mud along the marshy shore, a few inches above the water. From the shallows near by, the animal gathers mud and weeds to make the jetty; this also serves to deepen and clear the water, so that the owner can plunge in to safety. Besides those constructed by themselves, the Rats select and use readymade landing places, such as roots and stones by the water's edge.

They commonly leave their dung on these jetties. This marks them clearly, and probably serves as a record, as already noted (See Plate LXXII, p. 589).

In voiding its dung, the animal prefers to have its body dry and its tail in the water. One which I kept in captivity, was so particular about this, that it invariably turned its tail-end into the little water trough, keeping that in a very unfragrant condition, although the water was changed more than once each day. The origin of this custom was no doubt in the necessity for keeping the house clean. This they could be sure of doing if at each voidance, each Muskrat took the trouble to drop its tail over the threshold into the canal, which thus formed at once waterway, moat, and trunk-sewer for the inhabitants.

Hauling Docks

In every pond frequented by Muskrats will be found the hauling docks, where they bring bundles of sedge, etc., from the deep water to be eaten at leisure. These docks—or rather the bundles of herbage piled on them—are a conspicuous notice to the wood-wise that here are Muskrats to be found—and t * * * * * d, if one is so disposed.

The Foes of Wah-jusk

I had always supposed that Wah-jusk of the Moated Mounds was remarkably free from parasites. I knew, as set forth in "Life Histories," that a sort of fur-louse was found on this species, as on every creature that wears fur; but considered it unimportant.

From Dr. C. E. Johnson's monograph on the Muskrat, I was pained to learn that this simple-minded, stout-hearted dweller in the sloughs, has an awful lot of troubles of his own. Dr. Johnson says: "The Muskrat is the host for a considerable number of parasitic worms belonging to the so-called flat-worm (*Platyhelminthes*) and the round-worm (*Nemathelminthes*) groups. . . .

"A suggestion as to the frequency of infestation among the Muskrats is found in the following statement by [F. D.] Barker:[29] 'In 42 Muskrats, 881 parasites were found. No parasites were found in 4 Muskrats; 3 harboured *cestodes*, *trematodes*, and *nematodes;* and 3 harboured a single species of *trematodes*.' . . .

"[B. W.] Evermann and [H. W.] Clark remark[30] that the Muskrat 'has long been suspected' of being the intermediate host of certain parasites which induce pearl formation on freshwater mussels."[31]

All of this was terribly disappointing, and yet exactly in the line of what I should have expected. We have seen that Wah-jusk himself is parasitic on the Beaver; and by Oliver Goldsmith we are assured that

> "Big fleas have little fleas
> Upon their backs to bite 'em;
> Little fleas have lesser fleas,
> And so ad infinitum."

Why, then, should the Haycock-builder of the marshes escape the common fate of flesh?

He does not. And the list of his parasites, big and little, increases as we proceed.

Besides these creeping, crawling, or microscopic little pests, he has a host of the big, blustering kind. In the air, hawks, owls; on the land, Weasels,

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[29] Parasites of the Muskrat, Science, N. S., 1915, p. 570.

[30] Lake Maxinkuckee: A Physical and Biological Survey, Indiana Dept. of Conservation, 1920, p. 467.

[31] Muskrat in N. Y., pp. 293–94.

Otters, Foxes, Wolves, and many others, consider him their lawful prey. In the water the pike and pickerel take him at a disadvantage.

But the worst of his animal foes is the Mink. This water-weasel abounds wherever the Muskrat does. It frequents the same places, it is aquatic, and can follow the Muskrat into his house, no matter how long or how crooked is the underwater trail to the door.

E. W. Deming, the animal-painter, tells me that when he lived on the Green River of Illinois in the '80's, he spent much time each winter catching Mink and Muskrat. He became familiar with their habits, and learned that the former feeds regularly on the latter. He once dug out a Mink, and found within its den the remains of 10 Muskrats. Apparently, the Rat has but one advantage, and that is he can *out-dive* the Mink. He is, moreover, a desperate fighter; when at bay, he never surrenders; and, as we shall see, a strong, old Muskrat may even defeat a small Mink in one of the narrow underwater ways, or other special circumstance.

There is yet another, and far more dangerous foe; the one dire and dreaded enemy of the species—that is, a severe winter, following a dry fall. The ponds are then so shallow that they freeze to the bottom, the Rats are either forced out to be at a helpless disadvantage on the snow among birds and beasts of prey or are sealed in so that they prey on each other.

Bellalise, my Indian guide on the Athabaska, told me that such a calamity took place in his trapping country in 1904. Next spring, he found 1, 2, up to 10, and in one case, 15 Muskrats, dead in the houses. They were exceedingly scarce in 1907; I saw not half a dozen during 6 months in their country, but they were slowly recovering, as so often before.

The following, by my boyhood idol—Captain Mayne Reid—illustrates the danger of a freeze-in that Muskrats face in a hard winter, if they do not bestir themselves to keep their doorways open. In three houses, the hunters found the occupants alive and well, but "on opening a fourth," he says, "a singular scene met our eyes. There was but one Muskrat alive, and that one seemed to be nearly famished to death. Its body was wasted to mere 'skin and bone', and the animal had evidently been a long time without food. Beside him, lay the naked skeletons of several small animals that I at once saw were those of the Muskrat. A glance at the bottom of the nest explained all. The hole, which in the other houses, had passed through the ice, and which we found quite open, in this one was frozen up. The animals had neglected keeping it open, until the ice had got too thick for them to break through; and then, impelled by the cravings of hunger, they had preyed upon each other, until only one, the strongest, survived!

"I found, upon counting the skeletons, that no less than 11 had tenanted this ice-bound prison."[32]

Such visitations have been periodic in the great Northland of the Muskrat range. When widespread, as sometimes happens, they amount almost to a wipe-out. It takes many years for the species to recover from such a terrible experience.

A Desperate Fighter

The fame of the Muskrat as a fighter has spread far and wide, and with abundant reason.

I once knew a migrant, militant, and malignant Muskrat hold three Horses and a mower at bay, when the field of grain was all cut except the short central swath in which the wanderer had taken refuge.

On another occasion, in Oct., 1883, while travelling over the prairies with Oxen, they swerved aside from the trail, and I caught a glimpse of something leaping at the nose of the near Ox. I jumped from the wagon, the Cattle ran away, leaving me to face—a big Muskrat. It had disputed the trail with the Oxen, and now came straight at me. Leaping for my leg, it fixed its teeth in my trousers, and held on till it was killed.

Again, at Carberry, Sept. 5, 1892, George Scollan brought me a Muskrat that was on the trail leading into Kennedy's Plain. It had claimed the right of way from him, and believed that right was might.

Another of these fighting adventures is reported by Dr. Fred J. Cadham, of Winnipeg. In Oct., 1903, while driving on the open prairie 7 miles west of the city, he saw a Muskrat travelling. He jumped out and gave chase, but it turned at once to fight him, and fought till killed.

Yet another from Germantown, Pa., is thus described by Arthur C. Emlen: "In the blizzard of 1899, a boy I know had a curious adventure with a Muskrat. He was coming home late one night, when he saw some dark object run across the lane in front of him; before he knew it, the Muskrat ran up his leg. No sooner was it thrown off than it started up the other leg. After quite a fight, the boy managed to kill the Muskrat with his umbrella. I saw both the Rat and the umbrella afterward; there was not much left of either. The strange part of this story is that it took place on a hill not very near any Muskrat haunts; so that the boy could not have been trespassing on the Muskrat's ground."[33]

Bellalise tells me that twice has he been attacked by Muskrats; in each

[32] The Hunters' Feast, about 1840, pp. 86–87.

[33] Letter, Oct. 7, 1900.

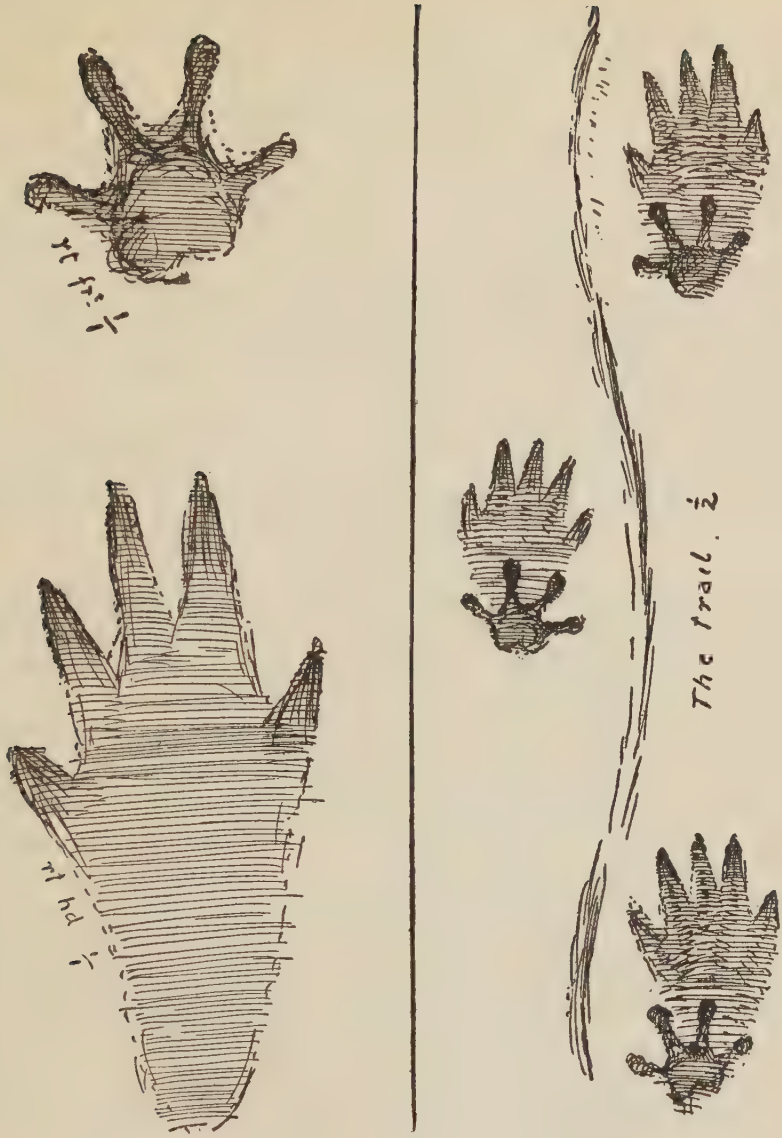

PLATE LXXIII.—TRACKS OF MUSKRAT

Those on left are fore and hind prints, life size. Those on right show the series as in the trail with the tail mark, half life size

case, he came on the Rats in an open place where there was no water, and no hole or cover. They could not get away, so the Rats went for him.

B. E. Ross, a merchant of Albert Lea, Minn., writes:[34] "On my way home from the store one moonlight night not long ago, my attention was attracted by a small animal crossing the street just ahead of me. . . .

"Soon he jumped upon the walk, and stopped in front of and facing me. I now saw it was a large Muskrat, and his attitude appeared much like a challenge. Of course, I could not take that, and began hostilities at once.

"I ran straight at him, and kicked with all my strength, striking him squarely, and lifting him about 30 feet. He lay stunned for a moment, but soon struggled to his feet. Much to my surprise, he came back again; and, on my starting in his direction, ran straight toward me. I began kicking again, but found he was still very much alive.

"He jumped and dodged so rapidly it was impossible for me to land on him again. Although fairly nimble on foot, I could not keep track of him, and he finally got hold of my leg, setting his teeth into it a great deal farther than was comfortable. Finally, I killed him with a club."

Most naturalists can contribute instances of the Muskrat's ferocity; but in none that have come under my notice, was the animal in the water. In each case, it was surprised on land; and, finding itself at a desperate disadvantage, it manifested the courage of desperation.

Since the above was written, O. J. Murie has sent notes of a remarkable exception. One spring, his brother "was canoeing up the Red River [Minn.], with a companion when they came on two Muskrats on the trunk of a tree which was so bent that it was flush with the water. One Muskrat dived into the river, but the other remained and seemed disposed to resent intrusion of strangers, facing the canoe and baring his teeth. My brother reached out with the paddle, and the Muskrat seized it and fought it. Then my brother got out on some limbs, approached the animal, and managed to seize him by the tail. The Muskrat was later released, whereupon he swam around the canoe for a time, apparently in no hurry, and he could easily have been caught again. . . . This incident, it seems to me, indicates that the Muskrat will fight even if a way of escape is at hand."[35]

Fighting for Mates

When an animal is a "natural-born scrapper," it is to be expected that his fiercest demonstrations will occur in the mating season. Among the Musk-

[34] Recreation, March, 1899, p. 198.

[35] Personal letter, Feb. 24, 1927.

rat males, at this time, desperate fights take place, if their loud snarling, splashing, and squealing at night are evidences. In these battles, the combatants' tails are often mangled—or, according to some trappers, even cut off.

W. Manly Hardy, of Brewer, Me., writes: "In the spring of the year . . . fully a fifth part of a catch . . . will show the marks of night-time squabbles and bog-land brawls. . . .

"I have taken them with a single bite $3\frac{1}{2}$ inches in length, and often so cut up as to be practically worthless for sale; but I remember none which showed such injuries as this one taken this year." He then describes the battered old warrior, as follows: "Besides having his head laid wide open on both sides—a great gash on the neck—others on the shoulders, and two very deep cuts on the hips, he was so bitten on the underparts that I could and did look directly into one of the wounds, and see his liver lying bare and exposed. Below that, and from another wound in the abdomen, there trailed a loop of the intestine some 3 or 4 inches in length. From another wound corresponding to this one, the green and chewed contents of the intestine was issuing so as to stain the fur at that point.

"Later, when I skinned the beast, I found that these last mentioned wounds showed evident signs of healing, while more recent cuts in other places proved that the owner of the skin had kept on fighting right up to the day when he got into the trap. . . .

"When it came to stretching the skin, I found fully 40 holes."[36]

Their Mode of Marriage

When animals fight so desperately for their mates, it generally means that they have some sort of a marriage contract in recognized form—possibly polygamy in this case, but with more evidence pointing toward monogamy. Nevertheless, this is a question not yet settled.

The following observations made at my home by Mrs. Mary Vanderburgh, give a glimpse of the family life that is scarcely compatible with polygamy:

"*May 17, 1905.* To-day, as I approached the bridge on the main drive in Wyndygoul Park, I saw a Muskrat on the opposite bank, busy collecting grass. As I stood quietly to watch, he rushed down the bank, apparently in a great hurry, with the grass protruding from either side of his mouth; and swam vigorously across the pool to the near shore where I stood. He was quickly followed by another, also with a load of grass. Both swam straight under the bank near where I was, and dived. They soon reappeared, and

[36] Forest & Stream, May 22, 1909, p. 811.

again set out for more grass, bringing it back in their mouths as before. This they did four times, and seemed to be working very hard. The fourth time, the first to reach the shore disappeared with its burden under the bank as before; but his companion suddenly turned to the right, and dived into the waterway at another place with his grass. I did not see him again, although the other reappeared, and swam across the pool toward the grassy bank. But this time, upon reaching there, it seemed to hesitate, and then swam to a small outlet, and disappeared in the bank; neither of them appearing again, although I waited for some time.

"Twice when these two animals met in midstream, but going in opposite directions, the one who had deposited his burden stopped and nibbled the face and side of the other; but the worker did not turn aside nor diminish the energy with which it made for the other shore. The pair were evidently associated, and, I think, were mates."

Finally, Miles Spencer, of Fort George, H. B., writing from personal experience, backed by many inquiries among the Indians, says[37] that the female is assisted by the male in rearing the young.

In summary, the general rule is that the males of polygamous animals do not concern themselves with the young; whereas, among the monogamous, the male divides all labour with the female, including the building and keeping up of the home. And this the male Muskrat certainly does. I have again and again seen two adult Muskrats swimming and working together in spring and early summer. In fact, it is the rule for a pair to be seen continually about each home den, as many naturalists testify.

Since such model paternalism is incompatible with polygamy, polyandry, or promiscuity, we must believe that the monogamy of the Muskrat is fairly well established.

Breeding

The breeding history of the species is but superficially known. In the latitude of Connecticut, the springtime mating is in late March. Analogy would fix the gestation at 30 days; but, so far, no definite information is on record. On the other hand, remembering the close kinship of Muskrat and Microtus, Lantz suggests that the gestation is probably 21 days.[38]

The young usually number 4 to 9, but the Biological Survey has records of 3, 6, 8, and 13 fetuses. Much higher numbers have been mentioned by some writers, but are to be received with caution. They were not actual

[37] A. P. Low, Expl. James Bay, Can. Geol. Surv., 1888, Pt. III, p. 78J.

[38] The Muskrat as a Fur-bearer, p. 7.

counts, or maybe included two families, etc. Any number over 10 is very exceptional. Lantz says: "The early spring litters are usually less in number, and those of midsummer are somewhat above the average."[39]

As examples of the low numbers, C. S. Brimley reports "2 embryos (very small) from a female, March, 7, 1895; and one from another, July 19, 1897."[40] This was at Raleigh, N. C.

It is commonly stated that the young of early spring may breed that autumn. I do not know of any positive evidence to support this.

Some observers hold that but one brood per season is the rule with the Muskrats; others—the majority indeed—believe that from 2 to 5 broods are usual, depending upon latitude, that is, the length of the warm-weather period.

Thus, Dr. C. E. Johnson offers evidence of two broods in Minnesota. On July 23d, he says, "5 young, about one third grown, were taken at a house on the North Kawishiwi, a short distance above Dead Man's Rapids; and on the same day in a near-by locality, a female was taken which contained 7 fetuses about the size of the common House-mouse."[41]

Lantz, evidently with the Middle States in mind, sums up all available testimony as follows: "The first litter is born in April; a second litter is due in June or early July; and a third in August or September. In favourable seasons, a fourth or even a fifth litter may be produced."[42] In this connection, it should be remembered that there is a difference between "litters" and "crops." That is, there may be a crop of young ones in April, June, August, and October, without, of necessity, the same pair producing at each of these times. These questions are still open.

The Musklings

In Connecticut, the young are born in late April. They are naked, blind, and helpless. They are suckled until three weeks or a month old. They begin to venture out about the middle of May. They are now one-third grown, and clad in fur of a peculiar leaden hue, quite different from that of the parents. In temper, too, they show an unspoiledness that proves all previous experience in the home to have been of the happiest. They have no knowledge of danger, trouble, or hate; as one must believe on the strength of many testimonies.

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[39] The Muskrat as a Fur-bearer, pp. 6–7.

[40] Journ. Mamm., Nov., 1923, p. 264.

[41] As above, Feb., 1922, p. 37.

[42] The Muskrat as a Fur-bearer, p. 7.

Thus, Dr. Gorden Bell tells me that in late Sept., 1901, at Lake Manitoba, he saw a young Muskrat about as "big as a goose-egg," and probably one fifth grown, on a rat-house, eating a green rush. He picked it up, and it sat on his hand, still eating. Presently, he set it down again on its house, where it continued feeding without fear or loss of time.

So also, Dr. John Bachman, telling of the young ones' coming-out party, says: "They are at this time very gentle; and we have, on several occasions, taken them up with the hand, without their making any violent struggles to escape, or attempts to punish us with their teeth."[43]

George H. Measham supplies a similar incident of "childish innocence." He writes me: "John J. Moncreiff told me that, when duck-shooting from a punt at the mouth of the Red River, Man., the punt moored in a bunch of black rushes. He and his companion, Isaac Pitblado, K.C., were much amused by the actions of a half-grown Rat. There was an old rat-house right beside their punt, and this youngster came to this resting place again and again, sometimes bringing a rush for refreshment, and at other times, fussing with his toilet. He paid no need to the reports of the guns. Eventually, Moncreiff lifted him by the scruff of the neck, and set him in the punt. He scrambled out into the water, and, in a few minutes, was back on the old rat-house, content and undisturbed."

The Heroic Mother

An interesting and surprising exhibition of mother care was witnessed by Edward R. Warren—nothing less than the mother Muskrat moving her young from a place of danger. It was in the Park at Colorado Springs, on the afternoon of July 2, 1921. He saw her carry her 7 young, one at a time, from a hole in the bank to an island in the pond. She carried each in her mouth, holding it high out of the water. The moving took about an hour, and was witnessed by a number of persons besides the naturalist. It is fully described in the Journal of Mammalogy, Aug., 1924, pp. 202–03.

But the climax of Muskrat courage is set forth by W. Everett Cram.[44] He relates the brave fight put up by a large, dark Muskrat—presumably the mother—to defend her three half-grown young ones from a small Mink. Having defeated and driven away that enemy, she was back in time to achieve a second victory over a larger Mink. The story is too long for reproduction here, but is commended to all who wish to see the Muskrat in the blazing light of heroism.

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[43] Quadrupeds of North America, I, 1849, p. 115.

[44] Journ. Mamm., Feb., 1923, pp. 22–26; 3 ills.

References

1910—The Muskrat, by David E. Lantz, U. S. Dept. Agri., Farmers' Bull. 396; April 30; 38 pp.; 5 ills.

1911—A Systematic Synopsis of the Muskrats, by N. Hollister, N. A. F. 32; 47 pp.; 1 map; many ills.

1917—The Muskrat as a Fur-bearer, by David E. Lantz, U. S. Dept. Agri., Farmers' Bull. 869; 23 pp.; 5 ills.

1925—The Muskrat in New York, by Dr. Charles E. Johnson, Roosevelt Wild Life Bull., Syracuse, March; pp. 194–322; 41 ills.; 3 maps.

Pa Porky: "It hurts me far more than it hurts you."

LIFE XC—THE PORCUPINE

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Canada Porcupine, Gray Porcupine, Quill-pig, Prickle-cub, Hedgehog, Porky-hog, Urson, Quiller

Erethizon dorsatum (Linnæus)

(Gr. *erethizon*, ppr. of *erethizein*, to excite or irritate; L. *dorsatum*, from *dorsum*, the back, in allusion to its formidable "backing" or "back armour")

[*Hystrix*] *dorsata* Linnæus, 1758, Syst. Nat., ed. X, I, p. 57.
E[*rethizon*] *dorsatum* F. Cuvier, 1822, Mém. Mus. d'Hist. Nat., Paris, IX, p. 432.

Type Locality—Eastern Canada, i.e., Quebec.

French Canadian, *l'Urson, le Porc-épic vélu.*
Cree, *Kahk.* Richardson gives it *Cawquaw.*
Sauteaux and Muskego, *Kagh.*
Ojibway, *Oga.*
Chipewyan, *Thee.*
Yankton Sioux, *Pah-hee.*
Ogallala Sioux, *Pah-hin.*

Porkespicke is the name given by Purchas[1]. *Porty-pine* is a half-breed corruption on Slave River.

The Porcupine Family, or *Erethizontidæ*, is sufficiently characterized in the generic description.

The genus *Erethizon* (F. Cuvier, 1822) comprises thickset, short-faced, large rodents. They have the lips all hairy, head and body *covered on back and sides with long, sharp spines;* tail, short, thick, spiny above; short ears; 4 toes on fore feet, 5 on hind feet; 4 mammæ, all pectoral.

Teeth:

$$\text{Inc. } \frac{1-1}{1-1}\text{; prem. } \frac{1-1}{1-1}\text{; mol. } \frac{3-3}{3-3} = 20$$

To these generic characters, the Canada Porcupine adds the following:

Size. Length, about 36 in. (914 mm.); tail, 6 in. (153 mm.); hind foot, $3\frac{1}{2}$ in. (89 mm.).

Weight. "Well-conditioned adults averaging from 15 to 20 pounds in weight."[2] Parke H. Struthers sends me the following summary concerning

[1] Pilgrimages, 1616, p. 933.
[2] Mamm. Adir., p. 300.

New Hampshire specimens, after weighing "over 100 individuals: 6 months old, weigh 6 to 9 lbs.; 1-year-old females weigh 9 to 12 lbs.; 1-year-old males weigh from 12 to 16 lbs.; adult females (over 1 year) weigh from 12 to 15 lbs.; adult males weigh 15 to 25 lbs."[3]

George A. Scott, M. L. A., shot a 28-lb. Porcupine at Davidson, Sask., in Oct., 1910.[4]

"Their maximum weight," says S. N. Rhoads, "when fat, is very great, reaching upward of 35 to 40 pounds."[5]

The following weights are recorded for the Arizona Porcupine: 8 lbs., 12 lbs., 13½ lbs.[6]

Colour. The general colour is a brownish black; but the tips of the long hairs on the back are more or less white or yellowish-white, especially on the shoulder. The front teeth are deep orange. The quills are white with dark tips; they show chiefly on nape, rump, and tail.

Freaks. In the museum at St. Johnsbury, Vt., is a pure albino Porcupine. In the New York Zoological Bulletin for Nov., 1921, is a picture of an albino. George Shiras 3d reports one living in the woods about White Fish Lake, Ont.[7]

Races

Two races are recognized:

dorsatum Linnæus, the typical form. T. l., Quebec.

picinum Bangs, distinguishable by its much blacker colour. T. l., L'Anse au Loup, Strait of Belle Isle, Labrador.

The Yellow-haired Porcupine (*Erethizon epixanthum*) replaces the Canada Porcupine in the Rocky Mountains from Arizona to Alaska. It differs most obviously in being streaked with yellow hairs instead of white on its body. It is found in 5 races. In habits, it is much like its Eastern cousin.

Range, Home Range, and Haunts

A comparison of the two maps—one of its range, and the other of the Faunal Areas—shows that the Porcupine is strictly limited on the south by the south edge of the Canadian Fauna, and on the north by the north edge

[3] Notes.

[4] Rod & Gun, Dec., 1910, p. 972.

[5] Mamm. Penn. & N. J., 1903, p. 118. In the North Dakota State Historical Society Museum, I was shown (July 12, 1927) a large yellow-haired Porcupine taken nearby, that according to Lewis F. Crawford, weighed 44 lbs.

[6] Forester's Report, Forest & Stream, Dec., 1924, p. 729.

[7] National Geogr. Mag., June, 1911, pp. 572–96.

of the Hudsonian. There are, however, islands of Canadian in the Middle Rockies that are without Porcupines.

William Couper is responsible for the statement that the Porcupine does not occur on Anticosti.[8]

The home range of the individual is extraordinarily small. Audubon and Bachman cite[9] a case of a Porcupine that confined itself "to a space of about two acres of ground through the winter." Hearne gives another good illustration of its local fixity. He says:[10] "They are so remarkably slow and stupid that our Indians, going with packets from Fort to Fort, often see them in the trees; but, not having occasion for them at that time, leave them till their return; and should their absence be a week or ten days, they are sure to find them within a mile of the place where they had seen them before."

Robillard, my Indian guide on the Athabaska, was even more emphatic. He said that a Porky will stay all winter in a bunch of three or four trees, if it finds food enough.

This unwandering disposition, combined with the unchanging abundance of its food, has resulted in the elimination of all migratory impulse, if it ever had any.

This hemlock or jackpine woods are the Porcupine's choice of haunts. Occasionally, it is found in the hardwood, if there be also a sprinkling of conifers and a few elms, basswoods, or aspens.

Numbers

In my early days about Lindsay, Ont., the Porcupine was extremely rare. This, however, was on the south edge of the Canadian Zone. I did not see one on my trip from Edmonton to Great Slave Lake in 1907, the nearest approach being the skin of one hung in a bush at Fort McMurray on the Athabaska, Oct. 17. They are rare along the river; but 20 miles east of it is a sandy country with jackpines. There they are plentiful; one may see 3 or 4 in a day without looking for them. On the south shore of Lake Athabaska, they are abundant. On Great Slave Lake, they are scarce, and found only as far east as the Narrows.

In Manitoba, I found them extremely scarce, and very punctilious about adhering to the Canadian Zone.

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[8]Forest & Stream, June 14, 1877, p. 300.

[9]Q. N. A., I, p. 283.

[10]Journey, p. 382.

MAP XVI.—RANGE OF THE PORCUPINES, OF THE PYGMY RABBIT, OF THE BRUSH RABBIT, AND OF THE ANTELOPE JACKS

By E. T. Seton, with assistance of the Biological Survey, 1927

In Itasca Co., Minn., the species is given by A. R. Cahn as "common throughout the county in suitable places; yet not nearly as common as the writer found the species either in north Wisconsin or in northern Michigan."[11]

In New Hampshire, it is according to C. F. Jackson, "fairly common throughout the northern two-thirds of the State."[12]

Struthers writes me, concerning two favourite localities in Cheshire Co., N. H. At one, Elliots, he "trapped 15 days, setting out 6 traps, and in that time have taken 35 Porcupines. In the other den, labelled 'Osgoods,' I have trapped 12 days, setting out 25 traps, and have taken 65 Porcupines." Both trappings were in 1926, and neither exhausted the local supply of the Quillers.[13]

In Maine, they are similarly abundant.

The Adirondack Mountains have more Porcupines than any other region I have lived in, but two or three a day is all one usually sees. There are, I suspect, few places to-day where they are at all numerous.

"In Labrador," says Dr. Robert Bell,[14] "the Porcupine is met with as far north as Nain, where it is common. It is met with everywhere in the region between the Great Lakes and Hudson's Bay, but is always scarce. Mr. Isbister, of the Nelson River House on the Churchill, informs me that it was once abundant there. It is rare between Lake Winnipeg and Hudson's Bay, but an individual is occasionally found as far north as York Factory."

William Case, of Cleveland, Ohio, wrote to Bachman, about 1840,[15] that Porcupines were very abundant in the Connecticut Western Reserve; "one person killed 7 or 8 in the course of an afternoon's hunt for Squirrels within three or four miles of this city."

In certain of the Catskills to-day, one may see a dozen Porcupines in a night about the camp. This, however, means that the population is concentrated there for a mile or two around. J. G. Bell tells[16] of 13 killed during one season in a grove that had about 100 cottonwood trees. This was on the Upper Missouri.

More exact data on their numbers will be found in the following from Napoleon A. Comeau's book.[17] "Prior to 1865," he says, "in the range of mountains known as the Ste. Anne Mountains, south shore of the St.

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[11] Journ. Mamm., May, 1921, p. 72.

[12] As above, Feb., 1922, p. 15.

[13] Notes.

[14] Mamm. Hud. Bay, Geol. Surv. Can., 1884, p. 49DD.

[15] Q. N. A., I, pp. 285–86.

[16] As above, pp. 282–83.

[17] Sport & Travel on the North Shore, 1909, pp. 80–84.

Lawrence between Gaspé and the city of Rimouski, Porcupines were found in abundance, and formed part of the winter supply of fresh meat to many of the scattered inhabitants of that region. One trapper and farmer combined named Dugas, told me that he frequently killed 6 or 7 Porcupines in a day's hunt, and from 100 to 130 in a season.

"In 1865, there was a migration of Fisher into that region; and two years later, all the Porcupine had been exterminated. The very same had occurred on the north shore in recent years. In my early days of trapping, the capture of Fisher was rare; and I have known old trappers who had never seen the animal alive. At that time, Porcupines were found in great numbers, particularly in that section of the country east of the Manicouagan River to the headwaters of the Ste. Marguerite. I mention this fact from personal observation.

"It was no unusual thing for an Indian family to capture from 150 to 200 Porcupines in a winter. . . .I have crossed in one day's walking, over 30 fresh yards or winter quarters of the Porcupine. A very low estimate of the numbers killed each year in the above limits, would be about 5,000 or 6,000. This continued during the 15 years that I trapped in that region, until about 1880, when the large migration of Fisher occurred, and the poor Porcupine were doomed. In two years, they were completely destroyed."

In certain regions where the Fisher is trapped out, and the Porcupine has every chance to multiply, the species has prospered till it is a nuisance. Essex County, N. Y., is one such region. In *Forest & Stream*[18] we learn that a bounty of 25 cents per head on Porcupine resulted in 3,617 of the creatures being killed on the 1,834 square miles of its territory.

In Minnesota, the State forest lands are laid out in forties; that is, squares of 40 acres each. Writing of conditions in that State, W. T. Cox, the surveyor, says: "The Porcupine . . . has become so abundant at Itasca that it commands the attention of the Park superintendent and other foresters engaged upon work in the forest. Recently, in marking trees for an improvement cutting, 26 forties were carefully gone over. Snow lay on the ground, and it was easier to see Porcupines than it would be in the summertime; and the men were able to obtain a fairly accurate count of these animals, and to determine what damage they were doing. On the 26 forties, 76 Porcupines were seen, or an average of 3 to the forty. Since there are 560 forty-acre tracts in this particular State Forest, it would seem that there must be in the neighbourhood of 1,600 Porcupines busily engaged in girdling trees on the reserve."[19]

[18] Nov. 28, 1908, p. 854.

[19] American Forestry, March, 1923, p. 161.

Habits in General

The Porcupine's best speed on the ground, is slow; but it is fast compared with its movements in the branches. Here it goes about like a Sloth, when it does move; often spending days in a single tree.

In the water, it floats because of its quills. Each quill is a little barrel of air to hold the creature up; and by paddling, it manages to traverse considerable distances. A half-grown specimen that I was photographing, took to the water to get rid of me; and swam with much splashing and little speed to the other shore, some 50 yards away.

Though it feeds and travels by both night and day, there can be no doubt that, like most quadrupeds it prefers the soft light of evening and early morning, taking advantage also of the substitute furnished by moonlight.

It does not need to hibernate, and is another proof of the theory that, given abundance of food, most animals will adapt themselves to any kind of climate.

The Woodland Fool

"The stupidest thing in the woods" is the descriptive epithet applied to the Porcupine by all who know it at home. It will waddle into almost any kind of danger, and eat almost any kind of food with utter disregard of consequences.

At Ingolf, Ont., on Sept. 16, 1904, in the woods near the railway, I found a dynamite box, and a stick of dynamite one-third eaten by a Porcupine. There were no Porky remains near, so evidently, he had not chewed hard enough.

You may drive the creature out of your camp with fire and sword; but that will not prevent its coming back—if able to crawl—within half an hour, to blunder into the same mischief as brought down vengeance before.

Eugene P. Bicknell says of those in the Catskills:[20] "The seeming nocturnal temerity of these creatures appeared to be simply an exhibition of excessive stupidity. It was found impossible to drive them from the camp for any length of time; they seemed to be destitute of the faculty of memory; and even a light charge of shot sent among them, was only for the moment effectual. Even when one particularly stupid individual had been shot dead in the doorway, trying to effect an entrance by gnawing its way through a gap, another, shortly after, continued the operation beside the lifeless body of its companion."

[20]Transactions of the Linnæan Society of N. Y., I, 1882, pp. 121–22.

No animal can manifest curiosity without having a hunger for information; and is, therefore, on the highway to knowledge. Dr. Hartley Jackson supplies us with an incident that proves, among other things, that the Quill-pig is of those who aspire to know.

"Just at dusk," he says, "on the evening of June 12, 1919, I caught sight of an adult Porcupine (*Erethizon dorsatum*) coming along a road through heavy timber in the Penokee Range, 8 miles southwest of Mellen, Wisconsin. I remained standing still. He approached in his slow, deliberate way, absolutely unaware of my presence. The air was calm, there being no detectable breeze. At a distance of about 20 feet from me, the animal stopped, looked up and around in different directions, and sniffed the air. He evidently was either rather suspicious or detected the odour of food. But he remained there only a second or two; then continued to within 15 feet; again stopped, looked directly at me, and sniffed for nearly two minutes, his nose in the air toward me all the while. Meantime, I withstood scores of biting mosquitoes, and remained perfectly silent. After 'sizing up' the situation, so to speak, the Porcupine changed his course an angle of 45 degrees, and came directly toward me. I remained silent until he began gnawing my leather puttees, when I thought it time to protest, so I made a slight movement, and Porkie scampered away and hid among the logs and brush by the roadside."[21]

Unsociable Yet Noisy

Entirely unsociable and non-gregarious, the Porcupine is among the most solitary of our quadrupeds. Half-a-dozen are sometimes found gathered at a lumber camp; but these are accidental meetings. They are drawn together, not for each other's company, but for attractive foods not found elsewhere in their woods.

The Porcupine sniffs, grunts, squeaks, whines, mews, chatters, sometimes shrieks, and even cries like a child. It has, indeed, an amazing collection of noises, considering how little it seems to use them for the benefit of its kind.

Bachman wrote[22] concerning a captive specimen at Charleston, S. C., "our efforts to force it from the tree were the only provocatives by which it could be made to growl at us. We occasionally heard it during the night, uttering a shrill note that might be called a low, querulous shriek."

E. P. Bicknell thus describes[23] their numbers and their noises on Slide

[21] Journ. Mamm., Nov., 1921, p. 238.

[22] Q. N. A., I, p. 283.

[23] Trans. Linn. Soc. N. Y., 1882, pp. 121–22.

Mountain (Catskills, N. Y.) in June, 1882: "From evening till morning dusk, our cabin, on the extreme summit of the mountain, was virtually besieged by them; and through the chinks, their dark forms could be seen moving about among the shadows in the moonlight, while their sharp cries, and often low conversational chatter, singularly like the voices of infants, were weird interruptions of the midnight silence, or later, of the moaning wind."

Describing the vocabulary of the Yellow-haired species in Alaska, Olaus J. Murie says: "The only sounds produced by the Porcupines were a combination snort and bark, an unexpected and startling sound heard on two occasions when the animal was approached suddenly; and a moaning sound, heard once, which my companion at first attributed to a cub Bear."[24]

Concerning the chattering, Struthers writes me that he considers this the normal language of the species, and so concludes "after experimenting with my own Porcupines with whom I carry on daily conversations in the teeth-chattering dialect."[25]

Love-song and War-cry

Discussing the possibility of a love-song in the species, P. A. Taverner says that while paddling on Muskoka Lake in early spring he "heard a most peculiar succession of cries coming from the shadows. . . . It was like the continued ya-ya-ya-yaa-a-a-a of a young baby, and rose and fell with prolonged querulous quaverings. . . .

"A few days later, however, in broad daylight, the same cries were heard just back of the house; and immediate investigation showed that they proceeded from a big, fat Porkey in a small maple tree, who was telling the whole world how mournfully happy it was in the warm spring sun. I presume it was of the nature of a love-song, and for the attraction or delectation of a mate; at least, another Porcupine, presumably a mate, was found in the vicinity shortly after."[26]

George K. Cherrie writes me (Oct. 28, 1922) on what seems to be the Quiller's war-cry: "While I am absolutely sure that I would recognize the cry of the Porcupine the next time that I hear it, yet I doubt if I could describe it in a way that others might recognize the high-pitched hawklike scream that reverberated between the hills of one of my wood-lots (near Newfane, Windham Co., Vt.) on a warm afternoon, early in June.

"I had heard the scream several times during the afternoon, but did not know its source until one of my men informed me, 'Why, that's a Hedge-

[24] Journ. Mamm., May, 1926, p. 112.

[25] Notes.

[26] Ottawa Nat., April, 1918, p. 6.

hog!' Then I started up through the woods to verify the statement, and it did not take me long to locate the 'Hedgehog.' Not one, but two of them—about 35 or 40 feet from the ground in a good-sized hemlock. I watched them for a little time, and it was evident that there was no kindly feeling between the two. One, a very large animal, was perched near the trunk of the tree at the base of a large limb on which the smaller of the two animals clung—but 6 or 8 feet out. After due deliberation, the big fellow started out on the limb toward his smaller companion; his intentions may have been all right—I don't know, as to that—but I do know that a scream came from the smaller chap that did not sound joyous to my ears."

Both proved to be adult males.

Solemn but Playful

Although Enos Mills expressly says: "The Porcupine is the only animal that I have known which I have never seen play,"[27] we have some testimony in rebuttal from the pen of Mary Dartt, who wrote the adventures of Mrs. A. M. Maxwell, the woman naturalist of Denver. Mrs. Maxwell had a pet Porky of the Yellow-haired breed. Although full-grown when acquired, and very shy at first, kindness, feeding, and petting won him over; and Yockco became one of the favourites in her small menagerie. "At times," she says, "he was very playful, balancing himself on his hindfeet and tail; and with extended paws and open mouth, pretending he was about to pounce upon and bite his friends. He was quite fond of climbing into Mrs. Maxwell's lap for dainties and caresses."[28]

If his expression changed at all during these antics, he was unlike all Porcupines I ever studied.

Home and Affections

Various authorities attest that the Porcupine's nest may be in a hollow tree or log, a cave, a hole under a rock, or maybe in the ground under the roots of trees. The only one I ever saw was the winter nest of an old male near Ottawa; it was in a deep crevice of a low, rocky ledge. The bed was a poor affair; and outside of it, was a great pile of dung, showing that it had been the animal's headquarters for a long time.

The marriage customs of the Porcupines are not fully known. By all the rules and evidence, they should be very solemn affairs. Those whose opportunities have been such that they should know, have filled the un-

[27] Adv. Nature Guide, 1923, p. 205.

[28] On the Plains and Among the Peaks, 1879, pp. 50–51.

fortunate blanks with some rare and picturesque myths that need not be recorded, except by sample.

Hearne says:[29] "Their mode of copulation is singular, for their quills will not permit them to perform that office in the usual mode, like other quadrupeds. To remedy this inconvenience, they sometimes lie on their sides, and meet in that manner; but the usual mode is for the male to lie on his back, and the female to walk over him (beginning at his head), till the parts of generation come in contact."

One of my guides assured me that the female, after some vocal discussion of the problem, hung, back down, on the underside of a small limb high up in a tree, while the male took a perch on the limb above and proceeded as per regulations. This was late in October.

I never saw one of this species at the time of copulation, but witnessed the act in the Crested Porcupine, and found it not different from that of other rodents. The female had such power over the posterior quills that they were radiated out of the way; obviously, she had complete control of the situation.

Apparently, the Canada species achieves its purpose similarly; for Struthers writes me concerning a pair that he kept in the attic of his house in Syracuse: "My attention was drawn to this pair several days previous by their love-making, and always remaining near each other. My animals sleep during the day, and I noticed this pair sleeping close together. Towards nightfall (5 P.M., Feb. 11) I went to feed them, and the pair in question were in the act of copulating. The female stood on all four legs, the tail held off to the right side. The male mounted her from behind, his forelegs pressing against her sides. As soon as the male saw me, he disengaged himself so that I was not able to tell how long the act would have been prolonged."[30]

Richardson and other Northern travellers say that the species pair in September. My Adirondack guide said October. In New Hampshire, according to Struthers, the mating time is between Nov. 15 and 30.[31] Thus, the testimony is strong that the mating takes place in fall. Nevertheless, the case actually witnessed by Struthers took place on Feb. 11.

The young are born about the end of April or the first of May, according to latitude. Struthers says that in Nelson, N. H., they are born between Feb. 15th and May 1st. They are of remarkably large size, which is evidence of a long gestation.

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[29] Journey, pp. 381–82.

[30] Personal letter, Feb. 16, 1927.

[31] Notes.

PLATE LXXIV.—PORCUPINE AT HOME

Struthers thinks that the species may breed twice each year, as he has seen young ones of but 2 or 3 pounds weight in September and in January.

The Big Little Ones

The young are said to be 1 or 2 in number, sometimes 3, rarely 4. Nevertheless, Struthers writes me that in over 79 pregnant females observed, all had but 1 fetus each.[32]

Bellalise tells me that in April, travelling through the deep snow, he once found a Porcupine and her two jet-black young ones. They were rather smooth, and had long, thick tails. This was on the south side of Lake Athabaska.

According to Merriam,[33] they "are born about the first of May [in the Adirondacks], and are monstrous for the size of the species. They are actually larger, and relatively more than 30 times larger, than the young of the Blackbear at birth. . . .

"May 1, 1882, I shot, at Big Moose Lake, a female Porcupine which contained a foetus that would certainly have been born within three or four days. It weighed $1\frac{1}{4}$ pounds avoirdupois (567 grm.), [a Blackbear at birth weighs about $\frac{1}{2}$ lb.] and measured in total length $11\frac{1}{4}$ inches (285 mm.), the head and body measuring about $7\frac{3}{4}$ inches (just 195 mm.). It was densely covered with long, black hair; and the quills on its back measured a little over half an inch (13 mm.) in length. The discoid placenta measured $2\frac{1}{4}$ inches (57 mm.) in diameter."

Concerning the further development of the young, I have no information beyond the fact that, early in August, I found young Porcupines half-grown in the Adirondacks, and already leading independent lives. What time they begin to leave the nest; whether they follow their mother and are cared for by her; and at what age they are fully grown, have not yet been recorded.

All observations at hand go to prove that the father takes no interest in his offspring.

Food when Aloft

In the winter, its native food is supposed to be exclusively the bark and twigs of hemlocks, aspen, jackpines, elm, basswood, cottonwood, and other trees; of these, its favourite is hemlock. Its method of feeding is thus described by Merriam:[34] "When he has selected and settled himself in a tree to

[32] Notes.

[33] Mamm. Adir., p. 305.

[34] As above, p. 302.

his liking, he may not leave it day or night until he has denuded it of the whole of its foliage. I have seen many hemlocks thus completely stripped, not a green twig remaining, even on the smallest bough. It seems incredible that so large and clumsy an animal should be able to climb out far enough on the branches to reach the terminal leaves; but he distributes his weight by bringing several branches together, and then, with his powerful paws, bends back their ends, and passes them through his mouth. When high in the tree tops, he is often passed unnoticed, mistaken, if seen at all, for the nest of a crow or hawk."

There is a tradition in the Northwest that the Porcupine never kills a tree if he can help it; carefully avoids a complete girdling of the bark. In jackpine woods, I have seen a great many instances that *looked* like this. But the fact is, the Porcupine climbs up to some comfortable crotch, and then gnaws at all the bark within easy reach. If there are crotches on both sides, he is likely to girdle the tree; if not, he takes the easiest way, which may mean go halfway around, then move to another fork.

The Southwestern Forest Experiment Station of Arizona reports that "in one series of experiments, a single small Porcupine weighing 8 pounds, gnawed off 34 square inches of bark in a single night. Another of 13½ pounds weight, disposed of 196 square inches in 6 days in a forest area about 90 feet square, choosing two large trees and 17 small ones. A third, a 12 pounder, took 300 square inches of bark in 6 days, girdling and killing 39 seedlings, and gnawing 32 others, as well as 5 large, young pine trees."[35]

Food when the Ice Is out

In the summer, its diet is more varied; doubtless, it eats all kinds of foods that are allowable to a strict vegetarian. Its fondness for lily-pads is well known, and is thus referred to by Merriam:[36]

"When feeding on lily-pads along the borders of watercourses, they sometimes utter extraordinary noises; and occasionally quarrels arise for the possession of some log which affords them easy access to the coveted plants. At Beaver Lake, in Lewis County, Mr. John Constable once witnessed an encounter during which one of the combatants was tumbled into the water. The animals did not attempt to bite, but growled, and snarled, and pushed."

Herrick[37] has given us interesting light on this food habit. He relates that, while out one July night, canoeing with jacklights: "Some heavy

[35] Forest & Stream, Dec., 1924, p. 729.

[36] Mamm. Adir., p. 303.

[37] Mamm. Minn., 1892, p. 247.

animal comes down to the water's edge where the banks are covered with a new growth of arrow-head leaf (*Sagittaria*), succulent and green; for it is June, and the receding waters have but lately exposed the roots to the sun. The clatter of teeth is again heard very loud and inexplicable, until we make out the gray form of a burly Porcupine, which at once starts up the bank much as an overfed Hog might do. A shot brought the animal to the water's edge. Another shot made it ours, and we found it an immense animal measuring over 3 feet from its blunt muzzle to the end of the spiny tail. The stomach of this specimen, a full-grown male, contained nothing but the finely comminuted shoots of *Sagittaria*."

Alvin R. Cahn says that in Itasca Co., Minn., the Porcupine "prefers the hardwood thickets, and feeds largely on the top-most branches of the ash (*Fraxinus americanus*) and the aspen (*Populus tremuloides*). Along the lake shores, it feeds upon the succulent stems and roots of the arrow-heads (*Sagittaria* sps.) and the white water-lily (*Castalia odorata*)."[38]

In amplification of this, Dr. C. E. Johnson says: In Minnesota "the majority of the Porcupines seen were met with while they were feeding at the edge of some lake or stream. In a number of instances, they were observed eating the rhizomes of water-lilies that had been pulled up by the Moose. The Porcupines were at times seen to secure this food, and no doubt also other kinds found in such places, by reaching down into the water full-length of the arm, feeling about until some object was encountered, and then hauling it in with the hand."[39]

This prepares us for the statement attested by several that the Porcupine follows the Moose around to profit by the roots of water-plants pulled up by the big brute as he feeds on the rhizomes of the lily.

Struthers details a case in which the Porcupines ruined a 3-acre field of corn, devouring it in less than a week. This was near Nelson, N. H.[40]

A Salt Addict

There is one very marked departure from its vegetarian diet that the Porcupine continually makes; and that is, it eats any sort of salt pork or butter that it can find, doubtless disliking the grease, but forcing it down for the joy of the salt. It is so keen after this delicacy that it will gnaw up every bit of wood that tastes in the least degree briny.

I have many times visited old mining shacks in the Rockies and lumber camps up the Ottawa, to find that the common fate of every wooden article

[38] Journ. Mamm., May, 1921, p. 72.

[39] As above, Feb., 1922, p. 38.

[40] Notes.

of furniture in the kitchen, from the meat block to the soup ladle, was to be devoured by Porcupines for the sake of the salt they held. It seems to be this weakness that brings them about the camp, where they are such a nuisance; and this, therefore, more than any other trait, brings on their death sentence from man. Doubtless, it is this hankering for salts and grease that makes them gnaw the cast antlers of Deer.

I think it likely that the craving for salts is the explanation of the following by O. J. Murie, concerning the Yellow-haired Porcupine in Alaska. He says: "Early in June of 1921 . . . on the Robertson River, I found Porcupines abundant on the river banks and sand-bars. Judging by my observations at that time, the Porcupines were feeding exclusively on mud. I watched many of them, and almost invariably saw that they were licking or chewing the fine sandy soil of the bars or river bank. At a distance of a few feet, one could hear the gritting of the sand in the animals' teeth, and could plainly see that there was not a vestige of vegetation near."[41]

The Quills

But the central thought in the Porcupine, the wonderful peculiarity, the secret of its life indeed, is its quill equipment. To specialize and grow quills, it has relinquished speed, cunning, and keenness of senses; all the revenues of its body seem to have been converted to the growing of those awful spines; and in the primitive times, when first evolved, the idea was absolutely justified by results.

The quills are about one inch long on the head, and 4 inches on the back; they are absent from the muzzle, the underparts, and the legs. They are so hidden in the wool and hair that they are hard to see, but are always unpleasantly easy to feel. They are so thickly placed that a Porcupine stripped of its wool and hair, as I have seen it by partial decomposition, is still clad densely with quills; each of these is a keen, many-barbed, and poisonous dagger.

Through the courtesy of the Geological Survey at Ottawa, I have had the opportunity to make an enlarged drawing of a representative quill (Plate LXXV, p. 619). The specimen was taken from the back of a stuffed Porcupine (*E. dorsatum*). I expected to find those of the tail more highly specialized, but was disappointed. Examples from head, back, and tail differed chiefly in size.

The extreme point is polished and keen. Very soon, i.e., after $\frac{1}{8}\frac{1}{2}$ of an inch, the barbs begin to show; these die away on the shoulder of the quill. I reckoned up a round thousand barbs on this specimen. When soaked in warm water, they stuck out much more; so we may believe that they also

[41] Notes, May, 1926, p. 111.

Quill from back of Porcupine; magnified 14 diameters. A, point; B, root or bulb

PLATE LXXV.—PORCUPINE DETAILS

flare out when in the warm flesh of the victim. The barrel is smooth, and highly polished. The bulb or root presented no special features.

A large male, taken at Berlin, Rensselaer Co., N. Y., Jan. 14, 1924 (No. 67892 Am. Mus.), on careful examination by G. G. Goodwin and myself, gave the following as conservative results of a count:

Head (armoured part)			$12\frac{1}{2}$	sq.	in.,	100	quills	per	sq.	in. 1,250
Body	"	"	240	"	"	140	"	"	"	" 33,600
Tail	"	"	16	"	"	100	"	"		" 1,600
										36,450

A representative female collected at the same place by Goodwin, gave, on careful calculation, a total of 24,480 quills.

Thus, Porky is protected by over 30,000 poisonous daggers, each more dangerous than the sting of a wasp! Imagine having 30,000 fearless wasps eternally on guard for your protection!

Thirty of these quills will repel a Dog; therefore, each Porky, we may say, is equipped to defeat 1,000 Dogs, as quickly as they care to come on.

How long it takes to grow a quill, is not known. But no one ever saw a wild Porcupine with bald spots, or any apparent shortage of spears. I suspect that, after even a serious affair with some enemy, the Porky will be wholly requilled before three months have passed by.

Are the Quills Shot?

The quills on the head and body are defensive; those on the tail are offensive, for the latter is thrashed about vigorously at a foe. The daggers, as a rule, leave the creature only after the point has entered the enemy; for, at the Porcupine's end, the quill is very loosely set in, and at the foeman's end, it is very tightly fixed, once it enters; and it has a thousand barbs to rankle and clinch, and defy all efforts to remove it.

Whether the festering of a quill-wound is due to an active poison on the point, or to the barbs, is unknown.

The quills, as is well known, are daggers, not arrows; for the creature does not shoot them at his foeman. Nevertheless, there can be no doubt that they are sometimes *thrown*, in a limited sense. Thus, L. V. Shaw, of Clements Port, Nova Scotia, writes on this subject:

"By a sudden jerk of his powerful tail, I have seen him throw loose quills a good distance; and if your flesh was close enough, probably [they would] stick in, and left serenely alone, would surely go through you."[42]

[42] Forest & Stream, June, 1924, p. 346.

Alexander H. Leighton, of Rosemont, Pa., says: "While hunting with a camera in the woods of Nova Scotia, during the summer of 1923, I saw a Porcupine, not 'shoot,' but throw his quills at least 5 feet, and strike a man. We found this Porcupine in a tree which we cut down; and my guides, with the aid of long, forked sticks, began driving him toward an open place where I should have light enough to photograph him. Suddenly, he took a notion to charge down a little path in a direction we did not wish him to go. One of the guides jumped in front of him, and held out a stick at arms' length to stop him. The Porcupine flicked his tail, and sent two quills into the guide's shoulder." Of course, as Leighton concludes, "the quills in the Porcupine's tail were loose, and struck the guide merely by accident."[43]

Unexpected use for the tail is announced by O. J. Murie. He says of a Porcupine that he watched closely: "Slowly and cautiously, it would hitch its way up the trunk, using the tail as a prop. The stiff bristles on the under surface were very useful here."[44] This carries us back to woodpecker methods.

On the Defensive

How are these daggers used? The creature does not curl up into a many-rayed globe—Hedgehog or globe-fish fashion—as some have told. I have tried many times to make it do so, without success. Indeed, if the animal be turned on its back (and it costs the investigator much effort to turn it, as it is sturdy on its legs), it lies exposed and helpless; which would not be the case if it had the habit of making itself into a ball. The old hunters say it never does so, except, perhaps, when falling from a height; and then it opens out on striking the ground. After many opportunities to observe, I can state that, on meeting an enemy from which it cannot escape, the Porcupine tucks its head under a root, a log, or other cover; raises its quills, radiating them all ways from the small of the back, and lashes with its tail at the slightest intimation of the foe being near. If it has no cover for its head, but happens to know of one in the direction of the enemy, it backs toward that switching its tail to clear the way. And there be few creatures indeed that do not heed the warning.

An adult female which I caught on the Oswegatchie, N. Y., was held with a noose on its hind foot while being examined. The foolish thing so resented this indignity that it lashed its own out-stretched foot full of quills; and it cost us no little trouble to get them out—as we felt in honour bound to do—before we let the fretful one go free.

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[43] Journ. Mamm., Feb., 1926, p. 61.

[44] As above, May, 1926, p. 112.

Meeting Open Attack

Bachman has left us this very exact picture of the Porcupine repelling a foe:[45] "A large, ferocious, and exceedingly troublesome mastiff, belonging to the neighbourhood had been in the habit of digging a hole under the fence, and entering our garden.

"Early one morning, we saw him making a dash at some object in the corner of the fence; which proved to be our Porcupine, which had, during the night, made its escape from the cage. The Dog seemed regardless of all its threats; and, probably supposing it to be an animal not more formidable than a Cat, sprang upon it, with open mouth. The Porcupine seemed to swell up in an instant, to nearly double its size; and as the Dog pounced upon it, it dealt him such a sidewise lateral blow with its tail as caused the mastiff to relinquish his hold instantly, and set up a loud howl in an agony of pain. His mouth, tongue, and nose were full of Porcupine quills. He could not close his jaws, but hurried open-mouthed out of the premises.

"It proved to him a lesson for life, as nothing could ever afterwards induce him to revisit a place where he had met with such an unneighbourly reception. Although the servants immediately extracted the spines from the mouth of the Dog, we observed that his head was terribly swelled for several weeks afterward; and it was two months before he finally recovered."

What dreadful punishment, in spite of immediate and skilful human aid! What would have been the offender's fate had he been a wild animal? Assuredly, death. The records of natural history abundantly prove it.

The Fools in Their Folly

"We have mentioned in our article on the Canada Lynx," says Bachman,[46] "that one of those animals was taken in the woods in a dying state, owing to its mouth being filled with Porcupine quills. We have heard of many Dogs, some Wolves, and at least one Panther, that were found dead, in consequence of inflammation produced by seizing on the Porcupine."

Manly Hardy lists the Fox, the Raccoon, and the Wildcat, among those he has found dead, slain by the quills of the Porcupine.[47]

On Sept. 16, 1901, in Rio Blanco Co., Colo., I found a Fox at the point of death from the quills of a Porcupine that he must have attacked some weeks before.

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[45] Q. N. A., I, p. 281.

[46] As above, p. 285.

[47] Shooting and Fishing, April 13, 1899, p. 526.

PLATE LXXVI.—PHOTOGRAPHS OF PORCUPINES

Nos. 1 and 2 are Arizona specimens in Washington Zoo. No. 8 is a Yellowhaired specimen taken by W. H. Wright. The rest are Canada Porcupines, taken by myself, except No. 7, which was taken by A. Radclyffe Dugmore

In the Blackbear Life (Vol. II, p. 145), is related the frightful punishment and miserable death of a Bear that essayed to make a meal of the Quiller.

Charles A. Wilding, of Fort Wayne, Ind., tells me that during a fishing trip into Canada, he once captured a huge snapping turtle whose fore feet were stuck full of Porcupine quills (Dec. 17, 1920).

A remarkable case of a horned owl, shot shortly after it had attacked a Porcupine, is detailed by C. E. Eifrig, of Ottawa, Ont.[48] It took place in Dec., 1907, at a place 50 miles northeast of the city; 66 Porcupine quills were taken out of that misguided owl's body.

In *Forest & Stream* of March 20, 1884, p. 144, J. L. Davidson, of Lockport, N. Y., states that he had recently examined a golden eagle that had been shot at Plessis, Jefferson Co., N. Y. He says: "The feet of the eagle were full of Porcupine quills, which was probably the last animal he had dined off."

In the *Auk*, April, 1922, p. 259, is an account by Albert Lano, of Fayetteville, Ark. It details the defeat and ultimate death of a golden eagle that tried to destroy a Porcupine.

An even more tragic affair has just been reported to me by the Postmaster of Laingsburg, Mich. Milton Williams, of that town, found an American eagle dead, and filled with quills that had evidently caused its death. Without doubt, the eagle had attacked the Porky, and had paid the extreme penalty of his folly.

A careful search in the annals of natural history will eventually put on the list of "killed by Porcupine" every savage flesh-eater in the region where the Quill-pig dwells.

A Cranky Bedfellow

The final and most amazing instance of the Quill-pig's power is found in the following. It is suggestive of the female spider that makes a practice of destroying her husband the morning after the wedding night. Dr. George W. Harvey, telling how his boy and his Dog Bose managed to do a Porky to its death, says:

"The next afternoon, the boy skinned and dissected the Porky, just to see what he had been eating, and how he was made. He first found that Bose had bitten the Porcupine's backbone in two in two places; and second that his intestines were perforated in no less than three different places by three of his own, a rival's, or his lady-love's quills, which, if the latter, would be Cupid's darts literally. In each instance, the quills were entirely through the

[48] Auk, Jan., 1909, p. 58.

intestine; an end protruding from either side, and held in place by a spindle-shaped ball of fecal matter, that must have revolved as the waste moved through the bowel like a shaft bearing a pully.

"In spite of these intestinal perforations, the Porcupine was as fat as a Seal; evidently in perfect health, and enjoying life to the full."[49]

Who Shall Make Him Afraid?

Who, then, are the enemies that this fearless one should fear? Setting the least first, we must begin with forest fires. The Deer and the Wolf can run before them or turn aside to purer air. But the slow Porcupine is enveloped in stifling fumes that extend their path of death for miles down-wind; and the higher he climbs, the surer his fate. For three years after the 1898 forest fire on the White River Plateau of Colorado, no Porcupines were seen.

But the fire is local and transient. The knight of many spears carries a worse foe within his own coat of mail—invisible, hidden, incombatable—and such are ever among the deadliest of foes. The measure of their damage is not known; and yet, of this we are assured: There are none worse. This secret plague, like the secret thought that dissolved an empire's army not so long ago, is no more than a worm—a tapeworm—the body-sapping *Bothiocephalus*.

The Terrible Pekan

It will be noted that in the list of creatures that fear the Quill-pig, we do not find the Pekan-Fisher. For reasons not understood, but set forth—as far as known—in the Fisher Life (Vol. II, p. 476), the Fisher is immune to the quills. He has no fear of Porky's attack. He loves Porky meat, and makes of him his favourite prey in countries where the Quiller still abounds. He is the chief natural foe of the Porky.

As we have already seen, there is a close relationship between the number of Porcupines and of Pekans in eastern Quebec. Similarly, the clearing out of the Pekans in western New York about 1820, was followed by conditions thus recorded: "Mr. Cozzens states that, of late years, they [Porcupines] have multiplied greatly; and are become numerous near Oneida Lake and in the northwestern part of the State of New York."[50]

As already noted, the Spiny's position of defense is with head thrust under any log or root; or, failing that, between his own fore legs, his belly hugging the ground, while his tail with lashings much more dreadful than those of Lion or Bull, girds blindly at the foe. But the Pekan, with foxy

[49] Forest & Stream, May, 1926, p. 280.

[50] J. & T. Doughty's Cabinet of Nat. Hist., I, 1830, p. 242.

craft, and arrowy speed, attacks, not with foolish canine jaw, but, with insidious catlike paw inserted underneath; upsets the dull, dazed skinner of the trees, and tears his belly open ere he can regain his invulnerable pose.

Why the Pekan does not suffer as do others of the red-toothed kind, is unknown. He is prodded and speared as others are; yet seems to live. Once only have I heard of a Fisher that succumbed to the barbs of the vengeful Quill-pig.

If he escape the attacks of all these foes, and succumb not to the traitor in his bowels, how long may Porky live? The only testimony at hand is this —that at White Fish Lake, Mich., was an albino Porcupine that George Shiras 3d photographed successfully for 6 consecutive years;[51] from which we may argue that the species may live at least that long. By the rule of 5 times the period of growth, the Porcupine may, barring Pekans and other accidents, live to the ripe age of 10 or 12 years.

When He Meets a Skunk

On the title page of this volume are figured the two Invincibles of the Woods—the two that have the right of way, the fear-born reverence of all dwellers in the wilds—the Skunk and the Porcupine. When these two meet—when the invincible meets the invulnerable—what next?

Enos Mills alone was privileged to see that meeting, and thus reports it: "Dull fellows well met were Skunk and Porcupine. These dull-brained but efficiently armed fellows are conceded the right of way by conventional wilderness folk. They blundered to head-on clash. Never before had this occurred. Each was surprised and wrathy. There was a gritting of teeth. Each pushed and became furious. Then the Skunk received several quills in the side, and, in turn, the Porcupine a dash of Skunk spray. Both abandoned the trail, sadder but not wiser."[52]

The Skunk would pay the heavy penalty, after weeks of pain; the Quill-pig would recover in three days. Is not this a proof of which has better weapons?

Worst, last, and deadliest of the Quill-pig's foes is man, as we shall see.

Porky Damage

Man has been the inveterate enemy of the Porcupine for three main reasons:

[51] Nat. Geogr. Mag., June, 1911, pp. 572–91.

[52] Watched by Wild Animals, 1922, p. 120.

First, damage to the hunting Dogs. Dogs are courageous enough to attack any foe, when they know that, backing them, is a man with a gun. In such a cocksure attitude, then, the Dog goes forth to destroy every living thing that it can find in the woods. It meets a baby Rabbit or a stranded half-grown Woodchuck, and on this it works its valiant will. Then it meets a Porcupine, and rushes mouthily upon him—to receive the punishment that a bully deserves.

"Around Anaconda, Mont.," writes T. L. Holliday, "the dog-lovers rightly consider the Porcupine a curse. I, for one, never let one escape if I can help it. We dare not go . . . hunting with the Dogs without taking our long-nosed electrician's pliers with us; for we never know when we will have to pull quills, and this tool is indispensable, especially to reach spikes that are far back in the mouth and on the tongue.

"In some cases, when Dogs are badly quilled, . . . and ether or chloroform is unavailable, it is impossible to save the Dogs. The two bitches . . . and one other old battler, 7 years old, were put under ether, and gone over very thoroughly, taking our time; but in spite of our care, I am yet pulling an occasional quill that works to the surface, point first. Yesterday, I took one out of the corner of the eye; to-day one came out through the very end of the nose; it has come up between the lip and the teeth."[53]

After one or two such experiences, some Dogs learn wisdom; but most do not.

Allan Brooks says:[54] "There are Dogs so pugnacious they attack every Porcupine they find, year after year. I once knew a bull Dog that killed dozens of them. Of course, he always got his face full of quills; and after the fight, would present himself at his master's house to have them pulled out. He was a big, powerful brute, and it always took two men to hold him while a third played dentist. Some of the quills would break off, leaving the barbed point imbedded in the flesh. These would invariably work through the Dog's head, and come out on the opposite side. Frequently, his head would, for a week or two, be swelled to twice its normal size. Running sores would result from the action of the quills; but still the plucky Dog would go after the Porcupines, even while his head was swelled till it looked like a Yankee pumpkin."

The fact that man is at hand with pinchers and salves does not, by any means, guarantee that the Dog will be all right in a month. In spite of immediate help, many a Dog has paid with his life, for an attack on the Tree Skinner. Yes, one may state it with even greater vigour—thousands of Dogs

[53] Field & Stream, Nov., 1921, p. 739.

[54] Western Porcupine, p. 343.

PLATE LXXVII.—THE LYNX MAKING A MISTAKE

have been killed by the combination of the Quill-pig's weapons and their own destructive folly. For this reason, all dog-men hate the Porcupine, utterly forgetting that Old Quills was never the aggressor, but was, in each case, merely defending his life in an unprovoked and unfair attack of 20 to 1 against him.

His Worst Crime

But the blackest crime with which our hero is charged is one that touches man's pocketbook. A stand of good timber is wealth; and the amount of potential wealth that one Porky can wipe out in a winter, is appalling.

Bachman credits the creature with destroying 100 big trees in a winter by girdling the bark.[55]

W. T. Cox, the lumber-cruiser, reporting on the conditions in the Minnesota pineries, says: "Careful note made as to the work of these animals, showed that each one had recently girdled and killed on an average 4.9 white pine trees. The trees were of an average diameter of 15 inches, representing the equivalent of 950 board feet of timber killed by each animal, or a total of 69,500 board feet on the 26 forties. This timber has a stumpage value of $8 per thousand feet. It will be seen, therefore, that the Porcupines of Itasca Park and Forest are killing each year approximately a million and a half feet of timber, worth on the stump $16,264, or approximately 1.2 per cent of the present annual growth. They constitute a source of damage which must be reckoned with in the management of the property."[56]

As a Camp-wrecker

Once a Porcupine has discovered your camp with its store of soups, salts, and flesh-stuff, nothing will restore peace by night but a wholesale massacre.

"To leave the soap out overnight," says Brooks,[57] "in a Porcupine country, means you will have to use sand to scrub with, the rest of the trip. The Porcupine will invariably get into any trap set for more valuable animals; and after eating up the bait, will sit comfortably down and await events, without trying to pull out."

In some mining regions, where rubber hose or automobiles are in use, the Querulous Quiller has developed a taste for rubber that adds to his unpopularity.

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[55] Q. N. A., I, p. 283.

[56] American Forestry, March, 1923, p. 161.

[57] Western Porcupine, p. 343.

You may drive him away, or shoot his wife or brother at his side—he will be back before you have been asleep more than ten minutes, to rattle his teeth on your saucepans, rasp and chip on the stock of your gun, squeal and whine and stamp as he squabbles with his friends. There is not a piece of wood in camp that he will not destroy if it be redolent of pork grease, or of sweat.

For these things, he is hated by campers.

His Service

Against infrequent fires and winter-famished Fishers, the Porcupine could still hold out. But man, in addition, was overmuch, and the balance turned. Quills grew scarce in all the lumber-woods.

Then a new thought came. Lumber-cruisers in the pineries got lost from time to time; and, armed only with a blazing-axe, they must find a Porcupine or starve. As these animals grew rare, the men *did* starve. So a new law exists to-day—the thorny rodent is protected under grievous penalties; and none but the starving may molest him. Furthermore, since his chief enemy is also the enemy of his enemies, and has killed off the Fishers, the Spiny race is prospering again.

The Indians have always viewed the Quill-pig as a food supply. Hearne says: "The flesh of the Porcupine is very delicious, and so much esteemed by the Indians that they think it the greatest luxury that their country affords."[58]

As we have already seen, the farmers as well as the hunters in the Rimouski region count, or used to count, on the Porcupine as a staple in their winter diet. Allan Brooks describes the flesh as "sweet and wholesome";[59] and discriminating testimony is offered by William S. Brown, of Alturas, Calif. He says:[60] "I have eaten Porcupine meat on several occasions during the past summer, and found it to be quite palatable. Only for the fact that the meat is coarser in texture, one could imagine he was eating beef—provided, of course, that the Porcupine is young. An old Porcupine is the toughest chewing imaginable." In this we see his use to man to-day.

But in bygone days, also, the Porcupine cut a large figure in the lives of our red brethren. George P. Belden says:[61] "The Crow Indians are the only ones who make combs. They are very simple, and consist of a Hedgehog's

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[58] Journey, p. 381.

[59] Western Porcupine, p. 343.

[60] Cal. F. & G., April, 1921, p. 127.

[61] Belden, The White Chief, 1872, p. 122.

tail, the bristles serving as teeth. When the Hog is killed, the tail is skinned off the bone, and a wooden handle inserted. When dry, it is ready for use, and is by no means a bad substitute for the bone or horn comb we use. A Hedgehog comb is an indispensable article to every Indian girl, as it enables her to keep her long black hair in order."

A still more æsthetic service was rendered by the Quill-pig. The quills—always the quills—were sought after by the Indian women for their fancy work. They were ready-made laces with a ready-made needle at one end. Dyed with roots, berries, barks, and lichens, to a buff, brown, black, red, green, and yellow, or left their natural white, they proved excellent material for the gorgeous embroidery of coats, moccasins, robes, and canoes. These things are famous now as the Red-man's art—an art that we believe was far too true to die; and yet will wield its influence in our modern world, even though it was the savage outcome of a savage's idea, expressed in the spines of a stupid beast, stained in dyes of the plants that it fed on.

His Way of Life

"Yes, that's something I *can do*," said Woodman Dobson. "I can take you to a Hedgehog. When it comes to Foxes, Coons, or even Deer, it's a gamble, but I can sure show you a Hedgehog." And so we set out from our camp on the Oswegatchie River.

An old camp is always a likely place for these creatures; and our first objective point was up the river, a mile and a half, to an abandoned logging shanty. There were plenty of Porky signs about the place. Every piece of wood that had been tainted with salt or grease was deeply gnawed; doubtless, the spiny ones found something here to fill a long-felt want. But not a Porky was to be seen. We tramped off through the woods, and after an hour came back. Dobson was ahead, and as he entered the tumbledown kitchen, shouted: "There he is! Look out, now, or he'll dodge into a hole!"

I hurried forward to see the Porcupine in a little wall-cupboard, where he had been enjoying the greasy, unsucculent shelf. But he had no desire for our acquaintance, and began to scramble down. Snatching a plank to serve as door, the guide shut him into this cupboard. I tore the whole box from its fastenings, and we carried it into the sunlight.

The activity of that spiny creature, and the energy and wrath with which he ground his teeth, were somewhat in contrast with the slow, logy Porcupines I used to know in Canada; and to prevent his escape, we had to slip a wire noose over one hind foot.

First, I examined him closely, and found that the summer moult was so

complete that his upper rear parts were naked except for the quills. These, when raised, radiated from the small of the back, or where that ought to be; in this case, it looked more like the broad of the back.

When tapped on the head or front parts, he tried to turn around; if touched on the hind parts, the tail flew up, or to one side, and left, in the offending stick or boot, a number of quills.

At length he broke the wire, and made off. I ran in front of him, whereupon he turned his back and came on, switching his tail viciously. I held up my foot; he struck the sole of my boot, and left half a dozen quills in it.

We now managed to get another noose on his hind foot, but the moment the leg was pulled straight, he switched that foot full of quills. Here was a quandary. Having made the necessary photographs, we had no right to let the Quill-pig go with his leg full of quills; and so, with much trouble and some danger—for Dobson got a couple of quills in his hand—we freed the Quiller from his own darts, and set him at liberty.

During this affair, that Porcupine lost not less than 150 of the poisoned daggers. It makes one wonder whether, in a series of encounters, he may not run short of ammunition.

All attempts to make this one climb a tree, or roll up like a ball, were failures.

The next day of our search, we passed through a grove of aspens. On the ground was the unmistakable after-evidence of a Porky feast, and I found the feaster dozing in a crotch some ten feet up. A deft push with a pole brought down the over-secure one; and he proceeded to perform for us, making first for a root under which he stuck his head. He defied us with fierce and rotary sweeps of his tail. A noose was slipped over a hind foot so we could hale him into full daylight, and again our prisoner lashed his own foot full of poisoned daggers. As before, we could not make him "ball." Then, as in duty bound, we held him under forked sticks, and removed the spears from his foot before letting him go.

He ran out on a log that was in the water; when I followed, he *retreated toward me* with threatening tail. Then at length he took to the water, and swam slowly, splashily, to the other side, some 50 yards away.

Yet again, I tried to photograph the Porky in the Adirondacks, at Loon Lake, in Aug., 1909. A native showed me the resort of a "Hedgehog." A load of barrels had been carried into the woods, with water to fight a forest fire. They had been left there; and, being pork barrels, attracted the Porcupine, who came and gnawed whenever he felt like having a chew. I went alone every day for five days, without seeing anything but a few fresh signs.

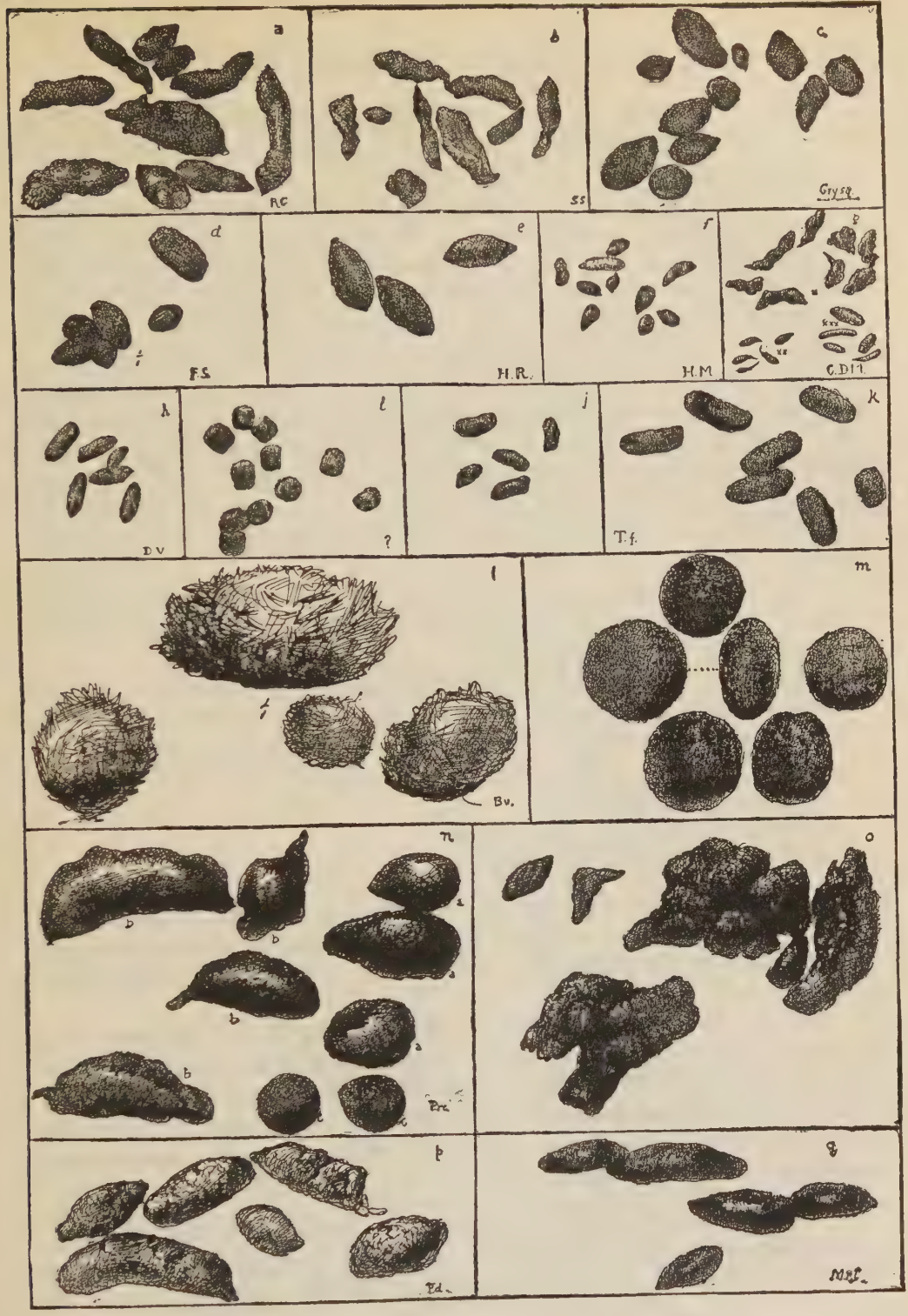

PLATE LXXVIII.—SCATOLOGY OF CERTAIN RODENTS

a. Richardson Ground-squirrel. *b*. Thirteen-striped Ground-squirrel. *c*. Carolina Gray-squirrel. *d*. Southern Flying-squirrel (*volans*). *e*. House-rat, living in the woods. *f*. House-mouse. *g*. Connecticut Deer-mouse (*noveboracensis*). (*x*) Fed on bread, etc. (*xx*) Different individual the night after capture. (*xxx*) Same as last, nut-fed for days. *h*. Drummond Vole. *i*. A Centipede. *j*. *Synaptomys cooperi*, ? Ottawa River. *k*. Pocket-gopher (*T. fossor*). *l*. Beaver, all woody fibre. *m*. Snowshoe-rabbit (winter). *n*. Porcupine, 3 different individuals, the large (*b*) wild, the others (*a*, *c*) captive. *o*. Woodchuck in October. *p*. Common Prairie-dog. *q*. Muskrat, September.

On the sixth day, I had a premonition of success, that was founded chiefly on a determination to win. I put a wire noose in my pocket, and went quietly to the place. He was not there.

Now I have always preached that each wild animal has a home-region and a routine of life, just as men have. To this rule the Quill-pig is no exception. One time he is in this den, another time in that; this day, he is eating lily-pads at the pond, next day, he is feeding on twigs of the hemlock grove. The home range of the Porky is small; without doubt, this creature was within a quarter of a mile of me at this moment. So I set about to find him.

The tracks and signs told me that he most often went southeastward from the barrel toward a hemlock ridge. I went cautiously in that direction, not following any one track; but noting with satisfaction that there were plenty of signs. Every few minutes, I paused and listened. At last, I heard a patter on the leaves. I was ready with a forked stick and a noose, and rushed forward. I surprised the Quilly One, turned him over, and noosed his hind foot before he could make for tree or hole.

When I picked him up, I judged his weight to be about six pounds; but before I had carried him at arm's length a quarter of a mile into an opening, unquestionably he weighed fully fifty-six pounds.

Of course, he began by lashing his foot full of spines; then he furnished me with some illustrations of his inverted drill manual, as follows:

On guard (which is turn tail and jam your head under a root).
Charge (which is backward).
Retreat (which is forward).
Thrust (which is a circular sweep).
Parry (which is an upper cut).

My intentions toward that Porky were quite honourable, but he treated me like a pickpocket or a highwayman. I think that he expended over a hundred darts in his attempt to repel me; and, of these, over twenty were in his own hind foot, of course.

The final thankless ceremony was dequilling the foot of the spiny one. He loved me not—before, during, or after the operation. As he waddled off into his hemlocks, I wondered if nature had provided him with some means of his own for resisting or extracting the poisoned shafts; a plan by which he might have helped himself, had I let him go without attempting the dangerous operation of removing the quills.

Another time, my guide and I went to a small lake called Gal-pond. While sitting on the bank, we heard a patter on the leaves behind us. Dobson whispered, "Hedgehog!" We ran toward it; but the creature, a large, old

fellow, made for a tree;" and in spite of forked sticks, succeeded in climbing out of reach, and out of view so far as the camera was concerned. I was for climbing after him, he was so obviously cornered; surely I could get some pictures up there. But Dobson said he had several times heard of such things, and once had seen a man climb after a Porky. It was a scene and a lesson never to be forgotten. As soon as the knight of many spears saw his enemy approaching him high in the tree, he backed down toward him, lashing that death-dealing tail of his. Unable to get down fast enough, and in imminent danger of a serious fall, the man threw up his arm to protect his face; and the quills on that fearsome tail speared it in fifty places. A hurried, horrid scramble to the ground was all that saved the man from still more dreadful punishment. But he had not by any means escaped a very full measure of the Quill-pig's wrath. Blood-poisoning set in, and for weeks, the arm was useless; at one time, it was feared that amputation would be necessary. It was several months before the man fully recovered from the vengeance of Old Quills.

So, good-bye, Quills; far be it from me to intrude.

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LIFE XCI—THE CONEY

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Coney, Calling Hare, Squeak-rabbit, Rock-rabbit, Starved Rat, Little Chief Hare, Pika, Ochotona, Slide-rat, Hay-maker, Mouse-hare

Ochotona princeps (Richardson)

(*Ochotona*, latinized from the Mongol name of the creature, *Ochodona;* L. *princeps*, chief)

Lepus (*Lagomys*) *princeps* RICHARDSON, 1828, Zool. Journ., III, p. 520.
[*Ochotona*] *princeps* TROUESSART, 1897, Catal. Mamm. viv. foss., p. 648.

TYPE LOCALITY—Head of Athabaska River, Alta.

Richardson mentions[1] that the Chipewyan Indian name for the Coney is *Bucka-thrae Kah-yawzae*, meaning "Little Chief Hare." In this, we recognize the familiar *Kah*, a Hare; *yazzi*, diminutive; while *Chief* is given by Alexander Mackenzie[2] as *Buchahudry*. The specific name is a latinization of this.

The Family *Ochotonidæ* is, so far as America is concerned, represented by the genus *Ochotona*. For our present purposes, therefore, the Family and generic characters are the same.

The genus *Ochotona* (Link, 1795), of which the present is the type, are small animals, each the size of a half-grown Rabbit, but presenting a combination of Mouse and Rabbit characters. The teeth are, in some respects mouselike; the general form is rabbitlike. The external tail is wholly absent, which is a Rabbit feature pushed to the limit. The molars are rootless, as in some Mice. The soles of the feet are hairy, which is rabbitlike. The ears are round, and short, which is mouselike. And it squeaks continually, which is a way of its own.

The teeth are:

$$\text{Inc. } \frac{2-2}{1-1}; \text{ prem. } \frac{3-3}{2-2}; \text{ mol. } \frac{2-2}{3-3} = 26$$

Taking Arthur H. Howell's Revision as our starting point, there are three species of Pika in North America:

(1) The Rocky Mountain form (*princeps*), a warm brownish-gray creature with buffy underparts and broad palatal bridge (2.3 mm).

[1] F. B. A., I, p. 227.

[2] Voyages from Montreal, 1801, p. cxxxii.

PLATE LXXIX.—CONIES AND THEIR HAY

From drawing by E. T. Seton

(2) The Slatey-crowned Pika (*schisticeps*), of the southwestern mountains; much like *princeps*, but with a slate-coloured head and narrow palatal bridge (1.6 mm.)

(3) The Alaska or Collared Pika (*collaris*). This is a gray creature with the underparts creamy white without any buffy wash; and an indistinct grayish collar on the shoulders.

The Coney of the Rocky Mountains combines the generic characters with the following specific details:

Size. Length, $7\frac{1}{2}$ in. (190 mm.); tail, 0; hind foot, $1\frac{1}{4}$ in. (32 mm.). The female is a little smaller.

Colour. In general, it looks much like a Packrat; that is, it is all over of a soft, woody brown, finely peppered or lined with dark hair-tips, especially on the central part of the lower back. The brown becomes deeper and more yellowish along cheeks and flanks. All below, including the feet, is whitish, with yellowish brown, and varied with the dark leaden underfur showing through. The face is like the back, but browner. The ears are blackish, with dull white rims.

In winter, the general colour is more gray.

The sexes are alike.

Races

It is found in 16 well-marked races, as follows:

princeps Richardson, the typical form. T. l., Headwater of the Athabaska River.

lutescens Howell, like *princeps*, but smaller and much paler. T. l., Mt. Inglesmaldie, near Banff, Alta.

levis Hollister, smaller and paler than *princeps;* like *lutescens*, but darker and buffier. T. l., Chief Mt. Lake, Alta.

lemhi Howell, like *princeps*, but smaller and very pale. T. l., Lemhi Mts., Ida.

ventorum Howell, like *princeps*, but paler and more buffy; with larger skull. T. l., Fremont Peak, Wyo.

uinta Hollister, like *ventorum*, but much more buffy, especially in summer. T. l., Uinta Mts., Utah.

nevadensis Howell, like *uinta*, but paler. T. l., Ruby Mts., Nev.

figginsi Allen, like *uinta*, but more grayish, less buffy, and more varied with blackish. T. l., Pagoda Peak, Colo.

saxatilis Bangs, much like *figginsi*, but paler and less vinaceous; like *ventorum*, but sides ochraceous-buff instead of pinkish

cinnamon; underparts buffy; more gray than *uinta*. T. l., Montgomery, Park Co., Colo.

incana Howell, much like *saxatilis*, but paler and less tawny. T. l., Pecos Baldy, N. M.

nigrescens Bailey, like *saxatilis*, but darker and more grayish; less brownish than *figginsi;* skull smaller than in *saxatilis*. T. l., Jemez Mts., N. M.

cuppes Bangs, like *princeps*, but darker; ochraceous-tawny above instead of cinnamon-buff; pinkish cinnamon below instead of pinkish buff. T. l., Monashee Divide, Gold Range, B. C.

fenisex Osgood, similar to *cuppes*, but paler and grayer; skull smaller. T. l., Ptarmigan Hill, head of Ashnola River, Cascade Range, B. C.

brooksi Howell, like *brunnescens*, but in winter, more cinnamon on head; more vinaceous in general; in summer, paler, more brownish than *fenisex*. T. l., Sicamous, B. C.

brunnescens Howell, similar to *fenisex*, but much more brownish above, and more buffy below. T. l., Keechelus, Kittatas Co., Wash.

fumosa Howell, size of *brunnescens*, with narrow skull; less brownish and more blackish above. T. l., Permilia Lake, Mt. Jefferson, Ore.

Range and Haunts

Map XVII (p. 639) shows that the Coney range includes an immense stretch of the mountains. Careful investigation indicates that, in the aggregate, the species really possesses but little of that stretch, being confined to certain small and narrow areas high up near timber line. These are great, open, rugged slopes—so rough, bleak, and inhospitable that there be almost no competitors in fur for possession of them; they are invariably slides of broken, tumbled rocks.

Numbers and Migration

My own travels have made me familiar with the high mountains from central Colorado to central British Columbia; and within this, I have never yet seen slide-rock up near timber-line without finding the little bump that squeak—squeak—squeaks from some low point of rock. About Pagoda Peak, Colo., I found them abundant in every rock-slide, Sept., 1901.

We have no satisfactory means of gauging their numbers. They must be less numerous than Mice, and more plentiful than Weasels; and the im-

MAP XVII.—RANGE OF THE 3 SPECIES OF CONEY AND OF THE POSSUM

By E. T. Seton, with assistance of the Biological Survey, 1927

O. princeps in the Rocky Mountains and Coast Ranges of Washington and Oregon; *O. collaris* in Yukon and Alaska; and *O. schisticeps* chiefly in California, Nevada, and Western region.

Range of the *Possum*. The California records are not entered; the spots in Colorado, Wisconsin, Michigan, New York, and New England are recent records.

mensity of the accredited range should be promise that they exist in millions.

We have a little light on their method of dispersal when the old rock-slide grows too tame or too congested for the young hopefuls. "During October of each year," says Anthony, "I have met with a few Picas a mile or more from the slides. A pair which took up a winter residence in a slab pile at my camp on East Eagle Creek, were about 2 miles from the nearest colony, and fully 1,500 feet lower in altitude."[3]

His Way of Life

No matter how horrible a certain climate or condition may seem to us, it is sure to be the ideal of some wild creature, its very dream of bliss. I suppose that slide-rock, away up in the cold, bleak, windy country above the timber-line, is absolutely the unloveliest landscape, the most repulsive home ground that a man could find in the mountains; and yet it is the paradise, the perfect place, of the Coney or Calling Hare. So that this wonderful little creature is found on the high peaks of the Rockies from California to Alaska.

His race is not especially abundant in the Yellowstone Park, but it was there that first I made his acquaintance; and Easterners will meet with him in the great Reserve more often than in all other parts of his range put together.

The Bump of Moss That Squeaks

As one reaches the Golden Gate, near Mammoth Hot Springs, Yellowstone Park, many little animals of the Ground-squirrel group are seen running about with occasional chirps and chatters. From the distance, comes a peculiar cry, a short squeak uttered every ten or fifteen seconds—"*e-week, e-week.*" You stop, perhaps search with your eye the remote hillside; but you are looking too far afield. Glance toward the tumbled rock piles, look at every high point. There on top of one, you note a little gray lump, like a bump of moss, the size of your fist, clinging to the point of the rock. Fix your glasses on it, and you will see plainly that the squeak is made by this tiny creature, like a month-old Rabbit, with short, round, white-rimmed ears, and no visible tail. This is the curious little animal that cannot be happy anywhere but in the slide-rock; this is the Calling Hare.

The driver calls it "Coney," or "Rock-rabbit"; and the old miners will tell you it is a "Starved Rat."

In colour, size, shape, and habits, he differs from all other creatures in

[3] Periodical Emigrations of Mammals, Journ. Mamm., Feb., 1923, p. 60.

the region; it is impossible to mistake him. Though a distant kinsman of the Rabbits, he is unlike them in looks and ways. Thus, he has, as noted, the very unrabbitlike habit of squeaking from some high lookout.

The squeak is doubtless a call of alarm to let the rest of the company know that there is danger about, for the Coney is a gregarious creature; there may be a hundred of the tribe in the rock-slide.

Some years ago, in Colorado, I sketched one of the Coneys by help of a field glass. He was putting all the force of his energetic little soul into the utterance of an alarm cry for the benefit of his people. The portrait appears on Plate LXXXI (p. 645).

His Personality

All of these habits are as unrabbitlike as may be; and scientists now even decline to refer the Coney to the Rabbit family as they formerly did.

Yet he has tokens of Rabbit kinship. As the California naturalists say: "When a Cony comes to 'attention' on an observation post, the head is often raised, the nose wiggled, and the feet 'shuffled,' all suggestive of mannerisms of a Rabbit; but the movements of the head are much quicker. The hobbly gait reminds one somewhat of the hopping of the Brush-rabbit. The Cony moves rapidly and with apparent ease, almost everywhere in a slide; even over very steep and smooth rock surfaces. We have never seen one of these animals assume the erect posture which is common to Rabbits."[4]

Florence Merriam Bailey offers an interesting glimpse of Coney life and manners, thus: "While the provident Conies of the rock-slide were gathering stores, others were taking their ease, coming up from the dark hollows between the rocks to sun themselves in characteristic statuesque attitudes—some with heads up, some squatting, with ears folded down like those of a frightened Rabbit; while one was seen washing its face with its paws like a kitten."[5]

His Hay-barn

But the most interesting habit of this unrabbity Rabbit is his way of preparing for winter.

When the grass, the mountain dandelions, and the peavines are at their best growth for making hay, the Coney, with his kind, goes warily from his stronghold in the rocks to the nearest stretch of herbage, and there cuts as much as he can carry of the richest growths. Then, laden with a bundle as high as himself, and very much longer, he makes for the rocks; and on some

[4] The Yosemite Cony, Grinnell & Storer, Sierra Club Bulletin, Vol. X, No. 2, 1917, p. 163.

[5] Forest & Stream, April 8, 1911, p. 531.

flat open place, spreads the herbage out to be cured for his winter hay. Out in full blaze of the sun he leaves it; and if some inconsiderate rock come in between, to cast a shadow on his hay a-curing, he moves the one of these that is easier to move; but he never neglects his hay.

When dry enough to be safe, he packs it away into his barn. This barn is a sheltered crevice in the rocks where the weather cannot harm the hay; and where it will continue good until the winter time, when otherwise there would be a sad pinch of famine in the Coney world. The trappers say that they can tell whether the winter will be hard or open by the amount of food stored up in the Coney barns. Which is simply a new form of the old and pleasing myth about the thickness of the fur presaging the hardness of the coming winter.

Many a one of these barns I have examined in the mountains of British Columbia and of Colorado, as well as in the Yellowstone Park. The quantity of hay in them varies from what might fill a peck measure to what would make a huge armful.

Among the food plants used, I found many species of grass, thistle, meadow-rue, pea-vine, heath, and the leaves of several composite plants. I suspect that fuller observations will show that they use every herb not actually poisonous, that grows in the vicinity of their citadel.

More than one of these wads of hay had in the middle of it, a nest or hollow—probably not the home nest where the young are raised, but a sort of winter restaurant whither they could repair while the ground was covered with snow; and, sitting in the midst of their provisions, eat to their hearts' content. It is not unlikely that in this we see the growth of the storage habit, beginning first with a warm nest of hay, which it was found could be utilized for food when none other was available.

The fact that these barns are used year after year is shown by the abundance of pellets in several layers which were found in and about them.

A pleasing picture of Coney-town in New Mexico, during harvest time, is offered by Florence M. Bailey. She was seated on a Coney-haunted slide, camera and notebook at hand, and relates:

"One of the small haymakers was hurrying back and forth, hard at work. Going to one especial place in the weeds outside of the slide, he would pick a green bouquet, and, carrying it in his mouth, run back to his haystack under the rock.

"Once, when carrying a load too big to see over, he ran plump against the foot of the photographer, frightening himself so that he scampered off and hid away in his cave.

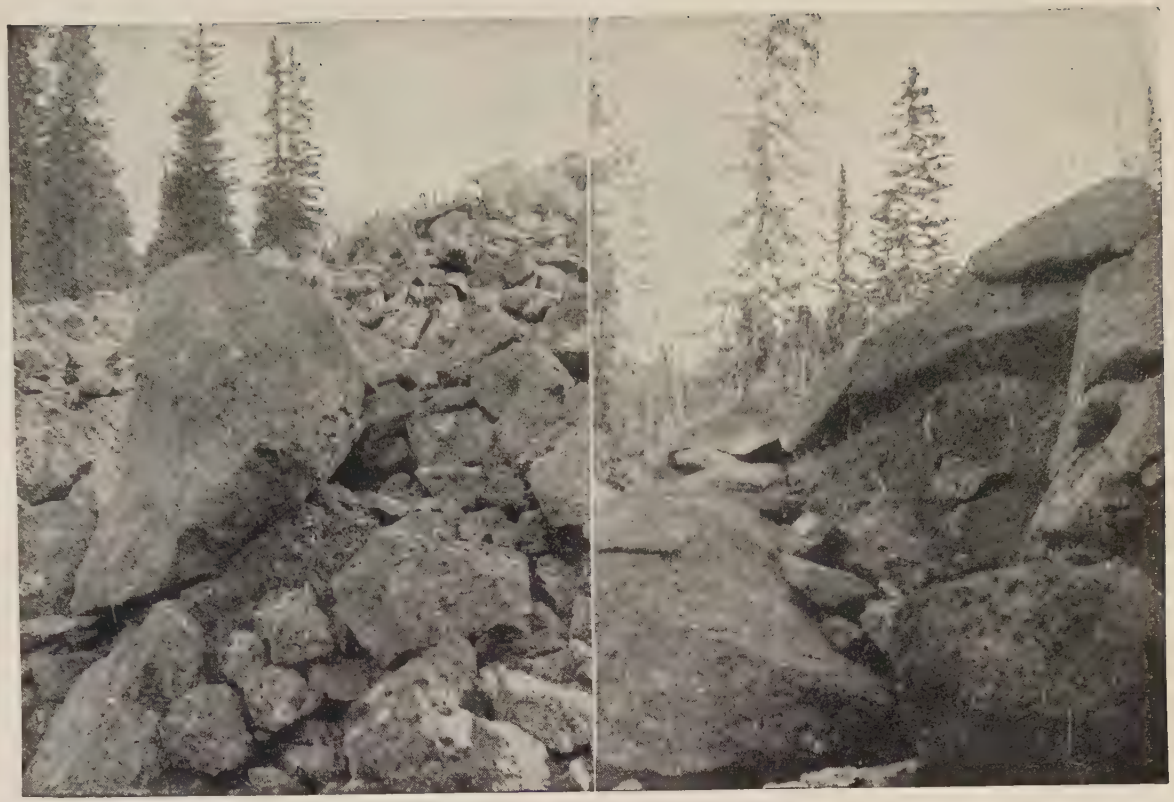

PLATE LXXX.—CONEY HAYBARNS

Photograph by E. T. Seton

"Another haymaker that I watched, an old one with brown fur, worked as if the cold storm had convinced him that winter was upon him. Unlike his systematic fellow who went and came to the same spots, he ran out into the weeds wherever the notion took him, and dumped his load of hay under a number of different stones, scattered about his end of the slide. He brought a variety of material—old brown leaves, fresh green grass, a bunch of asters, and once such a big bunch of cow parsnip that it was a wonder he wasn't tripped up by it. When he was photographed—at 10 feet, for he was apparently fearless—he was sitting on a rock with his mouth full of hay, a daisy sticking up from one corner like an Irishman's pipe. While resting between loads, at my insistent call, 'Go to work, Coney, go to work,' he would start off for his hay on a trot, perhaps startled by the voice, perhaps influenced by the urgency of the tone, which probably accorded with his meteorological observations."[6]

The Weatherwise Coney

A very wise little folk is this people of the rocks. Not only do they realize that, in summer, they must prepare for winter, but they know how to face a present crisis, however unexpected. To appreciate the following instance, we must remember that the central thought in the Coney's life is his "grub pile" for winter use; and next, that he is a strictly daytime animal. I have often slept near a Coney settlement, and never heard a sound or seen a sign of their being about after dark.

Nevertheless, Merriam tells us[7] that he and Vernon Bailey once carried their blankets up to a Coney colony above timber-line, in the Salmon River Mountains of Idaho, intending to spend the night there, and to study the Coneys, whose piles of hay were visible in all directions on their rocks. As this was about the first of September, it was natural to expect fair weather and a complete curing of the hay in a week or so. But a fierce storm set in with the descending night. The rain changed to hail, and then to snow; and, much to the surprise of the naturalists, they heard the squeak of the Coneys all night long.

These animals love the sunshine, the warmth, and the daylight, and dread cold and darkness as much as we do. It must have been a bitter experience when, at the call of the older ones, every little Coney had to tumble out of his warm bed in the chill, black hours, and face the driving sleet to save the winter's supplies. But tumble out they did; and overtime they worked, hard and well. When the morning dawned, the slide-rock and the

[6] Forest & Stream, April 8, 1911, p. 530.

[7] N. A. F., 5, 1891, p. 74.

whole world was covered deep in snow, but every haycock had been removed to a safe place under the rocks; and the wisdom of the Coney once more exemplified, with adequate energy to make it effective.

Winter Life

Bailey says: "Nothing is known of the habits of these animals in winter when they and their haystacks are buried deep under the snow, except that, in the spring, the haystacks are found reduced to a few dry sticks and stems, and the Ochotonas seem to have survived the Arctic winter in good condition."[8]

That they are active all the year, is evidenced by the following from M. P. Skinner, concerning the Coney-town at Golden Gate, Yellowstone Park: "I have seen them out repeatedly on mild winter days; and on Feb. 7, 1921, they were out on a bright, sunny morning when the temperature was actually far below zero Fahrenheit."[9]

Young

About all the light we have on the young of the species, is supplied by A. Brazier Howell, who says, concerning the Coney in Mono County, Calif.: "On July 20 . . . I shot from her favourite rock a female containing 3 rather large embryos; and two days later, a half-grown young from the same perch. This slide is too circumscribed to support more than a single family, so it appears that two litters are produced each year, at least, in some cases."[10]

Foes of the Little Chief

There is no flesh-eater that would not gladly eat the Squeaker; but the massive bulwarks of his mountain home defy all who would dig him out. Two classes only can secure his poor, thin body for their meal—the hawks who swoop swiftly round the mountain side, and snatch him from his rocky perch before he knows he is assailed; and the Weasels, thin, sinuous, persistent, that follow to his farthest hiding place. The fieldmen generally consider the chief and only dangerous enemies of the Hare are the Weasels,—Long-tailed, Short-tailed and Marten,—that seek him out, and slay him in his secret chamber. What offset he has devised for their onset, I do not know.

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[8] Science, New Series, XXV, Feb. 22, 1901, p. 307.

[9] Journ. Mamm., Aug., 1925, p. 202.

[10] Mamm. of Mammoth, Mono Co., Calif., Journ. Mamm., Feb., 1924, p. 35.

from life Pagoda Pk.
Colo 12 Sep 1901
E. T. S.
Coney Barn, filled with thistles, rue, peavine, heath leaves of a composite - also dung of both winter & summer
In the middle a nest.
Pagoda Peak. Colo
12 Sep. 1901
1/1
winter
summer
from photo by E R Warren
from photos by W. E Carlin
from life Colo 12 Sep 01
hind
fore
Right Feet 1/1

Plate LXXXI. Attitudes & Details of Coneys. by E. T. Seton

His Safety Is in the Rocks

No man has ever yet found the home nest of the Calling Hare. It is so securely hidden under rocks, and in galleries below rocks, that all attempts to dig it out have thus far failed. I know of several men, not to mention Bears, Badgers, Wolverines, and Grizzlies, who have essayed to unearth the secret of the Coney's inner life.

Following on the trail of a Coney that bleated derisively at me near Pagoda Peak, Colo., I began at once to roll rocks aside in an effort to follow him home to his den. The farther I went, the less satisfaction I found. The uncertain trail ramified more and more as I laboured. Once or twice from far below me, I heard a mocking squeak that spurred me on; but, at long length, that, too, ceased.

When about ten tons of rock had been removed, I was baffled. There were half a dozen possible lines of continuation, and while I paused to wipe the "honest sweat" from my well-meaning brow, I heard behind me the "*weak, weak,*" of my friend, as though giving his estimate of my resolution. Then I descried him—I suppose it was the same Coney—on a rock point, like a moss-bump against the sky-line away to the left. Only one end of the moss-bump moved a little each time a squeak was cast upon the air. I had not time to tear down the whole mountain, so I did as my betters, the Bears and Badgers, have done before me—I gave it up. I had, at least, found out why the Coney avoids the pleasant prairie and the fertile banks; and I finished with a new and profounder understanding of the Scripture text which says in effect: "As for the Coney, his safe refuge is in the rocks."

References

1924—Revision of the American Pikas, by Arthur H. Howell, *N. A. F.*, pp. 47, 57; 6 plates, 4 maps.

LIFE XCII—PRAIRIE-HARE

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Prairie-hare, Meadow-hare, Rocky Mountain Hare, Mountain Hare, Townsend's Hare, Whitetailed Jackrabbit, or White-jack

Lepus townsendii Bachman

(L. *Lepus*, a Hare; *townsendii*, in honour of J. K. Townsend, who collected the type specimen)

Lepus townsendii Bachman, 1837, Jour. Ac. Nat. Sci. Phila., VIII, Pt. I, p. 90, pl. 2.

Type Locality—Fort Walla Walla, Wash.

French Canadian, *le Lièvre.*
Ojibway, *Kit-chee-Wah-boos'* (big white Rabbit).
Yankton Sioux, *Mah-steen-cha Tung-ka.*
Ogallala Sioux, *Mahs-tin-shkah.*
Cree, *Mis-tah-boos'* (big white Rabbit).

The Family *Leporidæ* comprises large terrestrial rodents which have soft, dense fur, very long ears, long hind legs, short, bushy tail, and a remarkable duplication of the upper incisors—that is, behind the usual 2 in front of the upper jaw, is a rudimentary pair.

The genus *Lepus* (Linnæus, 1758) comprises rabbitlike animals of large size, covered with soft fur and underwool, never definitely spotted or striped. The northern species turn pure white in winter. They have long ears and legs; tail, medium or short; interior of mouth and soles of feet, hairy; fore feet with 5 toes, hind with 4; mammæ, 6 to 10.

Teeth:

$$\text{Inc. } \frac{2-2}{1-1}; \text{ can. } \frac{0-0}{0-0}; \text{ mol. } \frac{6-6}{5-5} = 28$$

With these generic characters, the Prairie-hare combines the following:

Size. A male from Asotin, Wash., taken Sept. 11, 1895 (No. 74840, Biol. Surv.): Length, $22\frac{1}{2}$ in. (571 mm.); tail, 3 in. (76 mm.); hind foot, $5\frac{7}{8}$ in. (149 mm.).

The specimen from which the drawing was made (Plate LXXXII, p. 650 was a representative female from Boissevain, Man., collected by A. S. Barton, Sept. 27, 1904. It is 2 feet (610 mm.) from nose tip to root of tail; the tail to tip of bone is about 4 in. (101 mm.). The hind foot, heel to end of longest claw, is 6 in. (152 mm.).

Weight. An adult specimen which I got at Carberry, Man., weighed only 6 lbs: A female shot at Gardiner, Mont., Aug. 16, 1897, was in milk; she weighed $7\frac{1}{4}$ lbs. Charles W. Nash records that he saw one at Mountain City, Man., that weighed 8 lbs. Dr. Sam J. Thompson, of Carberry, Man., shot a large one in his garden, and found that it weighed 11 lbs. Francis Dickey, of Carberry, tells me that, on Oct. 8, 1905, he shot a very large one that turned the scale at 12 lbs. These, doubtless, represent extreme weights; 7 or 8 lbs. is about average.

Colour. This animal is in general appearance, a silvery gray Hare, with white tail and underparts.

In detail the whole of the head and body above, as well as chest and legs, is of a soft, warm gray, thickly speckled or peppered with blackish brown, which is the middle part of each long hair showing through. Around the eye is a whitish ring. On the ears, the peppering is very fine. The ear behind, is velvety, snowy white, with black tip-spots, which is $1\frac{1}{2}$ in. long, and $\frac{1}{4}$ in. at the widest. The chin, breast, belly, and inside of the legs is snowy white. The tail is pure white, with a narrow band of dark gray on top. The foot bristles are dull yellowish.

A winter (Jan. 23) specimen from British Columbia (*Lake Osoyoos*) is similar, but of a paler, cooler gray above—a silvery gray.

In both, the nursery fringe is well marked, and there is a brown stain on the knees.

In the large series in the Biological Survey collection, there is not a winter specimen which is pure white. The nearest—a male from Salmon, Ida., Nov. 26, 1916—has the head above, ears, and fore paws softly silvered on the usual brownish gray, so as to look nearly white; all the rest, including tail, pure white.

In summer pelage (May and July), specimens from North Dakota resemble those from Idaho and Washington, but more tinged with buffy. All of *campanius* have the tail pure white above at all times; no stripe. In winter, they are pure white, except the head and ears, which continue gray.

The Prairie-hare is very pale compared with other Hares in summer coat, but its conspicuous label mark is the bushy *tail of pure white.* As it bounds away, this is held, not downward like that of a Texas Jack, or against his back like that of a Cottontail or a Snowshoe Rabbit, but straight out behind, or switched from side to side, like the white flag of a Whitetailed Deer. By this, and its size, the Prairie-hare may be known at all times.

Ears. Why has the Jackrabbit developed such ears? Not for hearing, I suspect. The plains animals are less in need of hearing gear than the wood

creatures. It is very clear what its long legs were made for, and it is possible that the general demand for increased extremities was indiscriminately applied, resulting in a beneficial lengthening of its four important outliers, and a fortuitous development of tail and ears.

The only use I can see for the additional ear-flaps is as a sort of roof when it squats in its form during hard rains. They cover its back like two long leather shingles, or a pair of empty gloves; and may ward off many an attack of pneumonia, etc. Their position when the owner squats, is exactly like that of a seaman's or fireman's hat, and similarly may serve to keep the floods from pouring down the back of the wearer's neck.

Races

The three recognized races are:

townsendii Bachman, the typical form. T. l., Fort Walla Walla, Wash.

campanius Hollister, a large form, found in the rich prairies; darker and richer in colour than *townsendii*, with larger black spots on ears; tail, pure white above and below at all times. T. l., Carlton House, Sask.

sierræ Merriam, from the Sierra, the largest of all; darker than *townsendii*, and much browner; paler than *campanius*, with much black on ears. T. l., Hope Valley, Alpine Co., Calif.

Range and Invasion of Manitoba

This, the largest of the Hares in Temperate North America, is exceeded in size by some of the Arctic and subarctic species only. It has a wide distribution on prairies, plains, mountains, and in forests of the Northwest, apparently influenced by little but climate.

In Manitoba, it is now found on all prairies, but it seems to have been unknown in the early days, although Richardson gives[1] it a general range that includes the southwestern part of the Province.

Alexander Henry, in his voluminous notes on the creatures of Red River Valley (1799 to 1814) did not record it for Manitoba, and but once for North Dakota, as follows:

On Oct. 21, 1804,[2] while mounted on his "famous gray Horse," and hunting near the junction of Pembina and Red Rivers in Dakota, he "started a large Meadow-hare, and killed it only after a long chase, as they are very swift."

[1] F. B. A., I, 1829, p. 224.

[2] Journal, p. 251.

PLATE LXXXII.—PRAIRIE-HARE

(*Lepus campestris* Bachman)
A female specimen taken at Boissevain, Manitoba, September 27, 1904

Kennicott, the naturalist, who searched the Red River Valley for small animals about 1856, did not meet with it. Professor H. Y. Hind explored all the Manitoban prairies in 1858–59, without finding one. J. H. Cadham, who came to Winnipeg in 1870, tells me that it was then unknown in Manitoba. Dr. Elliott Coues, in 1873, collected birds and quadrupeds all along the southern boundary of Canada, from Pembina westward, and did not meet with the Prairie-hare till he got on the Côteau du Missouri, or over 50 miles west of the Manitoban line.[3] In 1882, I travelled all summer on the Plains of the Souris, from Pembina River west to Turtle Mountain, and southwest from Brandon; and from Carberry over the northwest country toward Fort Pelly, without seeing or hearing of a Prairie-hare. In 1883–84, I camped over the prairies north and east of the Assiniboine, and still met with none but the common American Wood-hare. But in Sept., 1883, Miller Christy saw a Prairie-hare just west of Fort Ellice; and in 1885, George F. Guernsey reported it common at Fort Qu'Appelle.

A. S. Barton, of Boissevain, writes me: "The first Jack I ever heard of here was in 1881; since then, they have increased." C. W. Nash saw one killed at Mountain City in March, 1887.

On Aug. 26, 1892, I collected a specimen at Carberry. This was the first record for Manitoba north of the Assiniboine; none of the residents had ever seen one before. In 1894, Dr. S. J. Thompson tells me, they became common at Carberry; and in 1897–98, were so plentiful that one could see 15 or 20 in a mile drive. About Napinka, especially, they had become extremely numerous in 1898; and were proportionately destructive to the crops. They now abound in all the rolling prairie region of the Province.

J. H. Cadham, after 35 years' residence in Manitoba, tells me that the first he ever saw was near Winnipeg in 1896; in 1898, the species was seen for the first time at a place 6 miles west of Stony Mountain. Farmers who had lived there 15 years, had never seen one before. The species has steadily increased, and is now found in all the prairie country east of Red River, but not north of Winnipeg yet on the east side of the river. The united testimony of witnesses is that this Jackrabbit is now found in all the open regions of the Province, that it has continually advanced from the southwest, and is now generally abundant.

Introductions

At Fayette, Ia., on Feb. 27, 1905, I met Thomas L. Green, the postmaster, a well-known old-timer, who assured me that Jackrabbits were

[3] Field Notes, 49th Parall., 1878, Geol. Surv. Bull. 3, Vol. IV. p. 457.

unknown there 20 years before; but that about 1890 or 1895, they came in, and now were plentiful.

When at Lake Mashipecong, N. J., on June 12, 1920, I gathered the testimony of a number of old residents and native sportsmen, who informed me that Whitetailed Jacks had been introduced from the West, and were now found in the open fields.

In the Journal of Mammalogy[4] is a note from Dr. Hartley Jackson, recording the fact that the species has been introduced into Wisconsin.

About 20 years ago, I tried to introduce the Whitetail in Greenwich, Conn.; but none survived the second year.

Haunts and Home Range

Although called Prairie-hare, I have seen this species in the pine forests of California, and high up among the Rocky Mountains of Wyoming and Montana, as well as on the sage deserts. It is, indeed, less strictly a "prairie" Hare than many of its relatives; and I note with interest that in some parts of Manitoba, it is called "Mountain-hare." The prairie with scattering low cover is, nevertheless, its favourite haunts, and it shows also a remarkable partiality for the ploughed parts. In such footing the Hare is very much at home, though most running animals find it a disadvantage. Possibly, we may discover in this, one explanation of the Hare's spreading with the spread of cultivation. An advantage connected with this, possibly, is that the ploughing of the ground destroys the germs of many diseases that might otherwise make havoc in their numbers.

The home range of the individual Hare is probably not more than 2 miles across, maybe even smaller. It is well known that, when pursued, this animal rarely runs more than a mile from a central point, but circles around that; also that a Hare, once discovered, may usually be found thereafter within a few hundred yards of the same place.

In 1892, while I was living at Carberry, William H. White told me one evening, that an immense Rabbit or Hare was on his pea-field that day. It was some new kind, larger than any he had ever seen in the country before, and that if it was like its cousin, the English Hare, it would be found on the same spot, at the same time next day. This proved correct; I found the Hare in its form on the pea-field. It turned out to be the present species.

In the Park at Wyndygoul, where I had Whitetails for years, I found that each individual kept closely to his own region of 10 or 15 acres, though free of 120.

[4] Aug., 1920, p. 186.

Analogy also bears out the theory of a limited range. T. W. Proger, the Welsh naturalist, writes me concerning the European Hare, which is closely akin to our own: "The home locality of the Hare is less than 2 miles across"; that is, a radius of 1 mile; around this, it runs when pursued. I have proved a similar habit in the Jackrabbit of Kansas. So that a small range is the family rule.

Numbers and Migrations

In the New York *Tribune* for Jan. 27, 1924, p. 7 of the magazine supplement, is the photograph of a pile of Jackrabbits taken in a 3-days' drive at New England, near Bismarck, N. D. The total bag was 7,250.

This Hare is not at all migratory. At most, it changes its range in winter to adjoining places that are warmer, or better supplied with food.

Crepuscular. Like most of its group, it shuns the noonday glare. Indeed, it is not at all a Sun-child, as are so many of the Order. Neither does it prefer the black night, but finds its choicest time to feed and roam, in the soft, half-light of the gloaming—sometimes an hour before sunrise, but more often in the evening as the shades begin to fall.

As a Freezer

In the Life of the Mule-deer (Vol. III, p. 361) I have emphasized the "freezing habit" of that animal—its power to turn into a motionless statue when that is obviously the safe play. All of the Rabbits are well gifted in this direction. Molly Cottontail is famous; and the present species is equally clever at the ruse.

The deception is more complete if the Hare refrains even from winking; and this it is said to do. There are questions that, in consequence, have been put:

Does the Hare sleep with its eyes open? Does the Hare wink?

Many times, I have watched a sitting Hare to see if it winked; but always failed till recently. At Settle Station, Yorkshire, England, a dozen English Hares were in a crate. I watched them at a distance of a couple of feet, to see if they winked. After two or three minutes without change, I took out my watch, and focussed on the biggest and liveliest of the lot. Four minutes more elapsed; that is, altogether possibly 7 minutes, during which time there was no wink. Then my subject gave two or three very elaborate, heavy, sweeping winks, after which he again dispensed with the operation for a long period.

Food

The food of the species is nearly everything that is green or grain. In the winter, it adds to the list the bark of many shrubs, and comes by night to the gardens and barnyards of the farmers for a delightful change in the form of oats, hay, turnips, cabbage, and indeed all the stock foods, for it has a "crop for all corn."

The British Hare is credited by Robert Drane, of Cardiff,[5] with habitually eating its own dung, thus securing all nutriment by a process of double digestion, a sort of reversible rumination or *post mortem* chewing of the cud. This frugal habit has not yet been observed in American Hares; frugality is not an American characteristic.

Unsociable and Uncommunicative

"Nor is the Prairie-hare in the least gregarious," says Coues.[6] "I have never seen nor heard of several together, and indeed it is rare to find even two together at any season whatever. It is one of the most solitary animals with which I have become acquainted. . . . I have never found any kind of locality even, which, presenting special attractions, might invite many Hares together."

Lewis and Clark recorded[7] over one hundred years ago that these Hares, "are generally found separate, and are never seen to associate in greater numbers than two or three."

In noting the Hare's methods of intercommunication, we must not forget its uniform, so distinctive with its blazonment of markings black and white—markings that plainly advertise to all the world the wearer's identity; notifying others of the species that this is one of their own kind, and therefore, it is needless to flee; or showing the carnivorous foe with equal certainty that this is a Jackrabbit of winged heels, and therefore it is useless to follow.

When captured, this Hare sometimes utters a loud, coarse squealing; it is not unlike the "*caw, caw, caw*" of a crow.

The Hare of Europe, a close kinsman, has a soft, plaintive call for the young; and the Blacktailed Jack, when fighting with its own kind, utters an angry "churr, churr." These sounds also are probably used by the Whitetailed Jack.

[5] Trans. Card. Nat. Hist. Soc., Pt. II, 1894–95.

[6] Prairie Hare, pp. 80–81.

[7] Expedition Missouri, 1804–06, Hosmer Ed., 1917, II, p. 190.

PLATE LXXXIII.—LIFE-STUDIES OF PRAIRIE-HARE

Mating Standards Loose

Mating apparently takes place about the end of April. It is not known whether the species pairs or not; probably it is polygamous, and the male, therefore, is unlikely to take an interest in the young. A. S. Barton writes me from Boissevain, Man.: "The Jackrabbits run in packs after the females; about 20th of April, many people told me they had seen 4 or 5 together, and I once saw 3 all in a string."

As evidence in point, I quote from my own journal:

Cos Cob, Conn., April 28, 1906. For the past two weeks, I have noted in the park at Wyndygoul, 2 Jackrabbits—one a Whitetail, the other a Blacktail—running and keeping together, evidently paired. [They continued together for a year afterward.] I have also seen at another part of the park 2 Whitetails running together. These things incline to show that the species does pair. In the former case, it looks as though they were at times guilty of mesalliance. The weight of evidence at present, however, would prove the Prairie-hare addicted to polygamy, or even a still lower order of matrimony—catch-as-catch-can.

Nesting and Young

The Prairie-hare has many forms or beds where it sits in certain seasons; but it is not known to prepare a nest or cradle for its young.

Gestation lasts 30 days with the true Hares; and no doubt, the rule applies here, as this is a true Hare. The young are born in June or even early July, often the latter in Montana, according to Dr. Coues,[8] who studied them in the Milk River country. They are 3 to 6 in number, 4 being the most frequent.

The young of the European Hare are born with eyes open, and continue in hiding for about three weeks, during which time they are suckled two or three times a day. The father, it is generally believed, takes no interest in the young. After a month, the little ones begin to follow the old one, and learn what to eat and what to let alone.

These remarks are found to be near the truth for the Prairie-hare.

Some interesting notes on the development of the young have been supplied me by Percy H. Selwyn, of Ottawa, Ont. The first Jackrabbit he ever saw in Manitoba was at Elliot Settlement, 18 miles southeast of Brandon, on May 25, 1885. He fired at it, it fell dead; and he was sorry to see that it was a female evidently within a few hours of becoming a mother, for there was something moving in her body. On performing the Cæsarian

[8] Prairie Hare, p. 83.

operation, he found 3 young, one dead from the shot, the other two very active and with *eyes open*. When set on the ground, they ran about so quickly as to be hard to catch. He took them home and raised them by spoon-feeding. From the first, they were perfectly tame, and became the most playful Rabbits he ever saw, leaping high in the air, and turning so as to alight facing the other way. When $3\frac{1}{2}$ months old, and about half-grown, they were killed by accident.

Similarly, A. S. Barton, after much experience among the Hares in southern Manitoba, writes me: "The young ones make good pets, they are so easy to raise on milk, and soon learn to drink out of a saucer."

When 5 to 6 weeks old, the young are big enough to shift for themselves.

Many observers believe that, in Manitoba, this Hare has two litters a year. Dr. Coues thought one litter a year was all it reared in Montana.

In the Yakima Valley (Wash.), the farmer assured me that the Whitetails breed every month of the year except February. This I interpret to mean that young ones are continually seen, except in the depth of winter; which would show at best that two or perhaps three broods are reared each year in the warmer regions of the Whitetails' range. But in the latitude of Manitoba, I believe one brood each season to be the rule.

Speed

The Whitetailed Jack is undoubtedly the speediest wild four-foot left on the northern prairies to-day. In my scale of swiftness, I have put it next to the Antelope. It is far faster than Dog, Coyote, or Fox, and can often outrun the greyhounds in an open chase. "Captain Lewis measured the leaps of this animal, and found them commonly from 18 to 21 feet;[9] and many observations lead to the conclusion that it can travel for a mile or more at the rate of nearly 30 miles an hour.

For example, on Oct. 24, 1924, I was travelling from Hartney to Ninette in southern Manitoba. A Jackrabbit ran alongside the train, exactly keeping pace with it for 100 yards. We were going at a known rate of 30 miles an hour.

This high velocity was doubtless a result of the severest pressure. I suppose we are safe in estimating that at least once a day a Jackrabbit must save itself by its speed, and at least once a week it is hard pressed in a long race for life.

An individual that I watched closely while it ran at its easy, unafraid gait, covered 52 yards in 13 hops over the snow—an average of 12 feet to the half-speed hop.

[9] Expedition, Hosmer ed., II, p. 190.

All the Jackrabbits have a habit of making an occasional bound straight up in the air, to take an observation in Springbok fashion. This custom, seen at its highest development in the Blacktailed Jack of Texas, is at a minimum in the present species—I suppose because all its bounds are of the nature of spy-hops.

Several times while watching the ill-matched pair mentioned in the section on "Mating" I have had good opportunities of comparing the gaits of the two species. The Whitetail runs like a Deer, with high, long bounds; the Blacktail, lower, with shorter, quicker bounds, and much more regularly punctuated with spy-hops. Their courses may be thus suggested by the lines in the accompanying diagram (Plate XCVIII, p. 750).

A Swimmer

The Prairie-hare does not love the water, yet takes to it fearlessly when it must; and proves a strong swimmer, for the good reason that it can progress by the same motions as those which enable it to move on land.

Throughout the Yakima Valley of Washington, I was told that the Whitetailed Jack never hesitated to plunge into any water that barred its path, if too broad to be overleaped. It always manages, however, to shorten the swim considerably by leaping as far as possible at the start.

An aquatic exploit by this Hare has been described to me by an eye-witness, Col. L. L. Hawkins, of Portland, Ore. In the late fall of 1880, he was at work with a gang on the Snake River, 60 miles above its junction with the Columbia. He and his men stopped at a long, narrow island. It was about 500 yards in length, and 150 yards across; the widest part was covered with scrub; the rest was a long, bare point. As they landed, they saw a big Whitetailed Jackrabbit jump into cover. The whole gang of men went after him. They were 15 in number; and forming a line across, soon drove him out into the open and narrow part. He raced to the far point, then back a couple of times. They came within 50 or 60 feet of him, and now were nearly shoulder to shoulder, as here the point was only 20 yards wide. Seeing no other escape, the Jack ran to the left of the island, raced straight across to gather speed, then on the right side at the exact water's edge, he leaped with all his power into the river—covering fully 20 feet in that jump—and struck out bravely for the shore, 100 yards away. He swam very high and fast, splashing with his front feet, and moving forward with jerks as though jumping from his hind feet; his ears were laid back, and although the river was deep, cold and swift, he crossed about as quickly as a Dog would have done, and lost very little through drifting. As soon as he got on shore, he shook the water from his coat; then, sitting up high, he took one

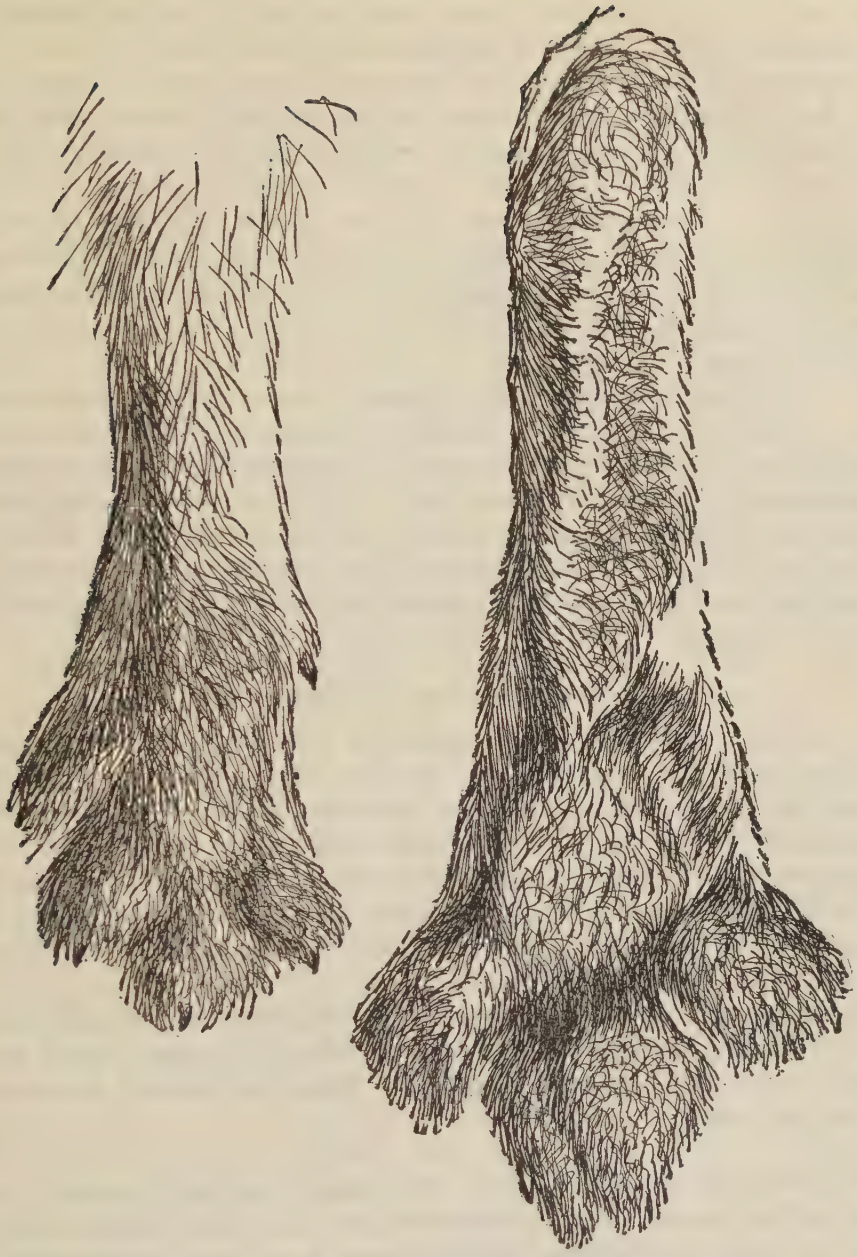

PLATE LXXXIV.—FEET OF PRAIRIE-HARE. LEFT FORE AND RIGHT HIND—LIFE SIZE. CHICAGO, MARCH 9, 1902

look at his foes, and bounded away into the sage. With one impulse, the men took off their hats, and gave him a cheer as he went.

When first they saw him on the island, Colonel Hawkins supposed the Jack had crossed over when the water was so low that there was a dry road; but, after seeing the way he swam, concluded that he crossed at any time he wished.

Dr. C. E. Johnson furnishes an even better instance: During the spring floods of 1900, he was at Warren, Minn. His Dog, a beast of Newfoundland blood, and the size of a setter, started a Jackrabbit which ran toward a flooded coulee; here the stream was about 50 feet wide, and going about 2 miles an hour.

"To my astonishment," says Johnson, "the racing Jack neither slackened its speed, nor swerved in the course to right or left. It had unlimited territory to either side, and had such a lead on the Dog that it could easily have chosen a different way. But it ran straight to the water's edge, plunged in without the slightest hesitation, and swam to the other side. Here it did not stop to shake the water from its fur, but bounded up the snow-covered banks, and sped on in the same general direction."[10] Ice-water! Ouch! Still he easily escaped.

His Foes and His Safety

The Hare is so swift that he needs but little art to escape his enemies. Cadham says that if pursued by one Dog, he commonly plays with it, teasing the Dog by allowing it to get very near. When two Dogs are turned loose, however, the Hare usually decides that present safety is better than posthumous glory; and proceeds to demonstrate that his are the winged heels and that nothing on four legs can catch him, when he wishes to leave the scene—as at present. When hard pressed, he is known to double back, make a tremendous side-jump, then squat.

An instance of this was told me by Chauncey Thomas, of Denver, Colo. He saw a wounded Jackrabbit walk along the railroad track for 200 yards, return, then jump and squat. The double he believed was intended to hide the track.

Hawks are among the Jack's most dangerous foes. Hamlin Garland tells me that, on the Colorado Plains, he once saw a Jackrabbit pursued by a hawk. The Jack made for a barbed-wire fence; and, dodging through, back and forth beneath it, easily escaped his enemy. The man-made importation gave the Jack an unusual protection.

[10] Journ. Mamm., Nov., 1925, pp. 247–48.

Another incident with a more heroic procedure is recorded as a "Jackrabbit's Savate"—savate being a French style of boxing in which kicking is the chief offensive. "A young professor in a South Dakota college witnessed a running fight between a hawk and a Jackrabbit last winter, and gives the readers of *The Companion* this interesting account of it:

"The Jack had ventured out from the natural protection of a cornfield upon a snow-covered prairie. He was discovered by a large hawk, which immediately sailed to the attack. As soon as the Rabbit saw his enemy approaching, he turned and made for the shelter of the cornfield. The hawk circled over him, and then made a swoop from the side across the Rabbit's path. For an instant, it seemed that the prize was his; but the Rabbit, with his ears lying back, continued to speed for the shelter ahead, until the hawk was nearly upon him. Then he suddenly stopped in his tracks; and as the hawk swept by just in front of him, he leaped high in the air, straight over the hawk; and, striking out with his powerful hind legs, sent his enemy tumbling in the snow.

"The Rabbit did it all with only a momentary pause that hardly checked the momentum of his rush for the cornfield. Four times the hawk rose in circles, and returned to the attack, to be met by the same novel method of defense. Each time the Rabbit stopped at the critical moment, and, leaping over his pursuer, struck with his strong legs. With a final burst of speed, he gained the cornfield, where the mat of stalks protected him from any further air raids."[11]

On the Central Plains, the golden eagle or war-eagle is to be reckoned with. Col. Theodore Roosevelt has described the tragic meeting of eagle and Jack as follows:

"On one occasion, while riding over the range, I witnessed an attack on a Jackrabbit. The eagle was soaring overhead and espied the Jack while the latter was crouched motionless. Instantly, the great bird rushed down through the humming air, with closed wings; checked itself when some 40 yards above the Jack, hovered for a moment, and again fell like a bolt. Away went Longears, running as only a frightened Jack can; and after him the eagle, not with the arrowy rush of its descent from high air, but with eager, hurried flapping. In a short time, it had nearly overtaken the fugitive, when the latter dodged sharply to one side, and the eagle overshot it precisely as a greyhound would have done, stopping itself by a powerful, setting motion of the great pinions. Twice this manœuvre was repeated; then the eagle made a quick rush, caught and overthrew the quarry before

[11] The Youth's Companion, Sept. 21, 1916, p. 528.

it could turn, and in another moment was sitting triumphant on the quivering body, the crooked talons driven deep into the soft, furry sides."[12]

The Fox is another enemy to be dreaded, chiefly, however, by the young; it is unlikely that it often secures a full-grown Jack. Dr. S. J. Thompson has given an incident that shows how this foe may be discomfited. While driving near Neepawa, Man., one day, Dr. Thompson saw a Jackrabbit that bounded along a prairie ridge, then suddenly squatted under a tussock. A Fox appeared close at hand; it also had seen the Rabbit, and slunk out of sight into a hollow, along which it ran as fast as it could, so as to come under the place where the Jack was sitting. As soon as it was within 50 yards, Reynard commenced an elaborate stalk, like a Cat, crawling on its belly till it was within 15 feet of the unwitting Rabbit. It was now as close as it could get undiscovered; so carefully placing each foot, it braced itself and made a grand leap, but fell short. The Jack was so alarmed that at first, he seemed to lose his head; jumped about back and forth and high in the air for a few times; but before the Fox could close, he got under way, and off they went. Within 100 yards, the Fox was left far behind and gave up the chase.

The Coyote was at one time a chief among the depredators of the Jackrabbit swarms—so much so, that the reduction of the Coyotes has resulted in a vast multiplication of the Jacks. In cultivated regions, the Jacks have been a menace to the crops, and the consequence is a reaction in favour of the Coyote as an essential counterpoise in nature's scheme.

Diseases

A deadly epidemic of some sort has appeared more than once among the Prairie-hares in the far West, when they have been unduly multiplied; but I have not heard of this occurring among those in Manitoba. The whole Family, however, is notoriously beset by disease. A. S. Barton writes: "We have not eaten any of them for years; so many have on the back a cyst full of watery fluid and quantities of white eggs, which I take to be the eggs of tape-worm. This disease, or whatever it is, does not affect the condition of the animal in the least."

On Feb. 25, 1907, I opened a 2-inch cyst on the side of a large male White-jack in Wyndygoul Park; on March 14, I opened a much larger one on the same animal. It contained about 2,000 embryonic tape-worms, the size of No. 6 shot. The cyst was $5\frac{1}{2}$ inches by $3\frac{1}{2}$ by 2 inches high. The Jack seemed indifferent alike to cyst, worms, and operation.

[12] Wilderness Hunter, 1893, pp. 71–72.

PLATE LXXXV.—PRAIRIE-HARE POSES

Photos. by E. T. Seton

Dr. T. S. Palmer, in his report on the Jackrabbits,[13] says: "Many persons have a prejudice against eating Jackrabbits because the animals are infested, at certain seasons, with parasites. . . . This prejudice, however, is entirely unfounded. The parasites of the Rabbit are not injurious to man; furthermore, the ticks and warbles occur at a season when the Rabbit should not be killed for game; while the tape-worm can only develop in certain of the lower animals, e.g., in the Dog or the Coyote. The most important parasites of the Jackrabbits are ticks (*Ixodes*), the larvæ of a fly (*Cuterebra*), and of a tape-worm (*Tænia*). Ticks are especially troublesome during the summer, and may sometimes be found clustered about the ears in great numbers. A large fly of the genus *Cuterebra* attacks these Hares as it does the Deer, Squirrels, and Wood-rats; and punctures the skin in order to find a suitable place to lay its eggs.

"The egg hatches soon after being deposited, and the parasite larvæ, becoming incased in a capsule immediately beneath the skin of its host, forms a lump sometimes an inch or more in length, which is usually known as a 'warble.' These warbles are most often seen in July or August. The larva emerges from its case in due time as a perfect insect; and the wound heals, leaving little or no scar.

"On some of the Rabbits brought to market, large 'water blisters' or 'boils' are occasionally found, which are the larvæ of a tape-worm (*Tænia serialis*). This larva is called *Cœnurus serialis*, and has been found in the California Jackrabbit (*Lepus californicus*), the Prairie-hare (*L. campestris*), the Old World Hare (*L. timidus*), and Rabbit (*L. cuniculus*), the Coypu of South America (*Myopotamus coypu*), a species of Squirrel (*Sciurus*), and in the Horse. *Cœnurus* does not develop into the adult tape-worm in any of these animals; but in the Dog and the Coyote, which eat many Rabbits, it reaches the adult stage."[14]

The Whitetails in my grounds have died from enteritis, pneumonia, and what I took to be hæmorrhagic septicæmia.

His Tale of Years

Having met and overcome this list of ills, what may be the tale of his years at their fullest expectation? What age does the hearty White-jack reach? Analogy is our only source of light here. Cowper's tame Hares of the British species lived, respectively, the male 8½ years, the female 10 years. Miller Christy tells me that he knew of an English Hare that lived 12 years in captivity.

[13] U. S. Dept. Agri. Bull. 8, 1896, pp. 71–72.

[14] This list of hosts of *Tænia serialis* was furnished by Dr. C. W. Stiles, U. S. Dept. Agri.

Jack in the Landscape

Who can adequately describe the wonderful thrill of delight—half animal, half poetic—that comes when first he sees a wild Deer bound away from his path? The old, old thrill it is, that dates from times when finding that Deer was a matter of life or death. This same vivific shock I never cease to get each time I see a Whitetailed Jackrabbit leap up from his near-by lurking place. It never fails to be two things—unexpected and superb. You never know where you may find a Jack—no one does—you never see him till he leaps at close range, and lopes away in stiff four-cornered bounds, rising without effort, like an Antelope, and switching his great white brush from side to side, like a miniature Whitetailed Deer: blazing with snowy white, and punctuated with sharp black spots on his ears. He is the king of all his kind, the largest and finest of the Hares that roam the great, high plains. The Blacktailed Jacks of New Mexico and California I got used to, without, however, entirely losing the little sudden taste of a naturalist's joy, as the live, lithe things sprung from my path; but the great Whitetail of the North, with its sudden leap into life and showy contrast on the plain, where a moment before it was a dead, invisible clod, never fails to give the hunter-thrill that can scarcely be felt when we slowly creep up on a larger creature that we have watched and stalked for hours.

A bright pen picture of this Hare in its home has been given by Dr. E. Coues:[15] "The first sign," he says, "one has usually of a Hare which has squatted low in hopes of concealment, till its fears force it to fly, is a great bound into the air, with lengthened body and erect ears. The instant it touches the ground, it is up again, with a peculiar springy jerk, more like rebounding of an elastic ball than the result of muscular exertion. It does not come fairly down and gather itself for the next spring, but seems to hold its legs stiffly extended, to touch only its toes, and rebound by the force of its impact. The action is strikingly suggestive of the 'bucking' of a Mule—an affair with which people in the West are only too familiar. With a succession of these high, jerky leaps, the animal makes off, generally in a straight course; there is nothing of the dodging or scuttling about that marks the running of the smaller Rabbits. As it gains on its pursuers, and its fears subside, the springs grow weaker, just as a flat stone 'skipped' on the water diminishes in length of the rebounds; and finally the animal squats in its tracks on its haunches with a jerk, to look and listen. . . .

"The attitude at such times is highly characteristic. One fore foot is advanced a little before the other, and the ears are held pointing in opposite

[15] Prairie Hare, pp. 84–85.

directions. A Hare in such an attitude as this is always upon the watch, and the slightest stimulation of its fears at such a time, is enough to start it on its bounding course. It is a beautiful exhibition of timid watchfulness."

Worth to Us

When in point, I have included in each of these Lives a consideration of the creature's value, or service to man. In the present case, this is not evident in material form. The Prairie-hare's pelt is so fragile, in fur and in hide, that it does not constitute an acceptable barter stock, even where the fur-trade rivalry is keenest. The flesh is wholesome food, but has never achieved any popularity. The Hare may yet establish itself as "desirable game," to which rank all sporting men should aim to help it as a measure of protection. But so far, it has hardly left the "vermin list," much less appeared on the "high game" where it should be.

In making apologetic enumeration of possible virtues, I feel myself guilty of something like special pleading, of making an appeal to the earthy jury, called "lawmakers"; for, after all, the creature's claim strongest with the lovers of the wild things, certainly with myself, is this—that, like so many I would save, without being able to prove their economic worth, the Hare is an exquisitely beautiful creature, an ornament to the plains, a delight to behold. I would preserve it, and a hundred others—even as I would preserve a beautiful picture or view—for the unsordid joy of feasting the eyes on a sentient fellow-creature, that is a little pinnacle on the cathedral of evolution, and glorious as an exemplar of beauty in the wild way of life.

References

1799–1814—Journal, by Alexander Henry, see Beaver References, p. 500.
1876—Synonymy, Description, History, Distribution and Habits of the Prairie Hare (*Lepus campestris*), by Dr. Elliott Coues, Bull. Essex Institute, VII (1875), pp. 73–85.

EUROPEAN HARE, in New England called JACKRABBIT
Lepus europæus Pallas

This large, handsome Hare has been introduced into America within the last 30 years, and is now established and abundant in several regions. It is found in the Hudson River Valley as far north as Albany, and eastward for 50 miles into the adjoining parts of Connecticut, Massachusetts, and Vermont. In New Jersey, it has appeared in the central and northern parts; and it has spread into the contiguous parts of Pennsylvania.

In Ontario, it is scattered over the counties immediately north of Lake Erie—that is, the whole peninsula west of Toronto and south of Alma.

Full information on the introduction and spread of the species is given by James Silver, of the Biological Survey, U. S. Dept. Agriculture.[16]

The European Hare is unlike any other in the region above named. First, it is much larger, being 9 or 10 pounds in weight. It is of deeper, richer colours than any of the large Hares in the West.

The only species in the East with which it needs comparison are the Cottontail, and the Snowshoe in summer pelage.

First, the Hare is by far the largest of the three—about double the weight of either of the others.

As to the colour: Above, the Hare is of a soft wood-brown or dull buff, thickly flecked with darker colour, due to the blackish lower part of the hairs showing through; the tips of the hairs are pale. The Cottontail is much redder in general—though gray on the rump—everywhere lined over with the black tips of the hairs overlying the rest. The Snowshoe is of a warm gray brown, much deeper and much yellower than the Hare, and peppered, as in the Cottontail, with black hair-tips.

The Hare's bib and flanks are reddish like the Cottontail's nape; the Cottontail's bib and flanks are soft buffy, like the Hare's back; the Snowshoe's bib and flanks are gray-brown like his own back. The Hare's nape is faintly reddish; that of the Cottontail, strongly reddish; that of the Snowshoe, without a trace of red.

All three are white below, but the Hare's chin and throat are reddish yellow; those of the Cottontail and the Snowshoe are white.

The underwool on the Hare's back is white; that in the Cottontail and the Snowhoe is dark leaden gray. The Hare and the Snowshoe always have a black tip on the ear behind; the Cottontail never has. The Hare's tail is black above, and snow white below; the Cottontail's is gray above, and snow white below; the Snowshoe's is very short, dark gray above, and dull whitish below.

According to James Silver, there are at least 50,000 of the European Hares now in this country, and the species is steadily increasing. Its life history is much like that of our Prairie Hare, and is fully set forth in J. G. Millais' "Mammals of Great Britain and Ireland," 1906, III, pp. 3–39.

[16] Journal of Agricultural Research, Vol. XXVIII, No. 11, June 14, 1924, pp. 1133–37.

LIFE XCIII—ARCTIC HARE

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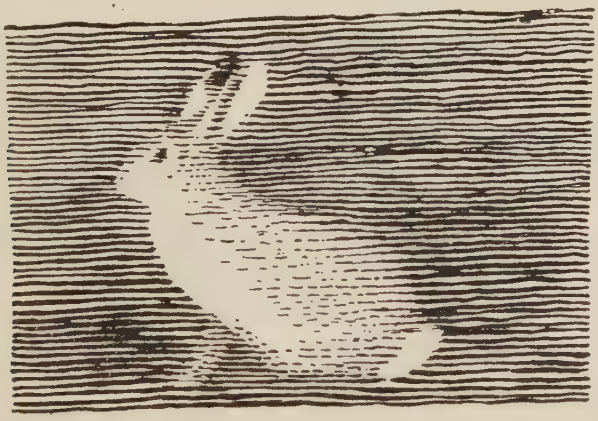

Arctic Hare, or Alpine Hare of Hudson's Bay

Lepus arcticus Ross

(L. *Lepus*, a Hare; L. *arcticus*, of the Arctic region)

Lepus arcticus Ross, 1819, Voy. Disc., 8vo. ed. II, App. IV, p. 151.

Type Locality—Lat. 73° 37′, in North Baffin Land, southeast of Cape Bowen

Eskimo, *Oo-ka-lik* (Richardson).
French. *Lièvre arctique d'Amérique.*
Chipewyan, *Ka-choh.*

As this is a creature of the Arctic fauna, but not in the region nearest the Pole, it is well to restrict the name "Arctic" to this, and "Polar" to the *groenlandicus*, which dwells nearer to the Pole.

Size. Total length, 24 in. (609 mm.); tail, 2½ in. (63 mm.); hind foot, 6½ in. (165 mm.); ear from notch in dried skin, 3¼ in. (82 mm.); ear from base behind on fresh specimen, 6 in. (152 mm.).

Weight. 8 lbs.[1] A female which I took at Aylmer Lake, Aug. 14, 1907, weighed 9¾ lbs.; a ⅔-grown female taken at the same place, Aug. 19, weighed 5 lbs. Richardson gives it at 7 to 14 lbs.[2] Hearne says that "they are, when full grown and in good condition, very large, many of them weighing 14 or 15 lbs."[3]

Colour. Summer coat: General colour of upper parts and chest, soft plumbaceous gray, thickly peppered; nose, brownish, shaded into the pale gray of the face; ear-tips, jet black; eye-rings, whitish; chin, pale leaden gray; tail, belly, and feet, pure white, except that the soles are stained deep brown. The nursery fringe is pure white, with a leaden tinge or stain on each knee.

In the northern part of Baffin Land, the summer coat continues entirely dull whitish, except the black tips to the ears.

In winter, everywhere pure white, except small black tips to ears; and, of course, the eyes, which are yellow.

[1] Fisher, Voy. Disc., p. 119.

[2] F. B. A., I, p. 222.

[3] Journey, p. 383.

Anatomy

Samuel Hearne, in the story of his famous journey to the Coppermine in 1774, tells of a curious thing about the Hare in these regions. After mentioning, to discredit, a popular notion that the Reddeer of England yearly sheds the glans of the penis, he says: "With equal truth, I can assert, and that from ocular demonstration, that the animal which is called the Alpine Hare in Hudson's Bay, actually undergoes something similar to that which is vulgarly ascribed to the English Deer. I have seen and handled several of them, who had been killed just after they had coupled in the Spring, with the *penises* hanging out, dried up, and shrivelled, like the navel-string of young animals; and on examinations, I always found a passage through them for the urine to pass."[4]

What the meaning of this is, I cannot say; but coming from Hearne, it is sure to have some foundation, and to be worthy of investigation.

Changing His Coat

In the northerly half of its range, this Hare continues white, or nearly white, all summer, for obvious reasons—the season is too short for a complete change, and the presence of snow and white ice all summer renders the change unnecessary.

In the southerly half of its range, the species begins to shed its white coat in April, early or late, according to latitude. For a time, it is in white and brown; so is the world about it. In May sometime, the change to brown is complete in those regions where it is made at all.

In October, those that were brown, resume the white coat. This includes the young which are, in all species, gray-brown; suggesting, if not proving, that the ancestral stock was brown, and the white coat a recent adaptation.

So white is this winter coat, that the creature might defy detection as it sits on the snow, but for the black ear-tips and bright amber eyes; and these, of course, do not betray it to an enemy far off. They may, however, be considered directive marks for its friends.

A young one in the gray-brown coat was captured, apparently on Boothia Peninsula, by Capt. J. C. Ross, and brought up as a pet. Concerning its change of colour, he says:

"Although constantly in a temperature never much below the freezing point, its fur assumed its white colour as early as those that were running

[4] Journey, p. 200.

wild, and exposed to the climate; and although it cast its winter coat early in May, it was replaced by a pure white fur."[5]

Races

The following races have been recognized:

arcticus Ross, the typical form. T. l., Baffin Land, S. E. of Cape Bowen.

bangsii Rhoads, much like southern *arcticus* in summer, but head duller buffy, grizzled with gray; body in full summer pelage, grizzled smoky gray; ears, nearly all glossy black. T. l., Codroy, Newfoundland.

canus Preble, much like southern *arcticus*, but paler gray on head and body. T. l., Hubbard Point, Hudson Bay, Canada.

othus Merriam, largest of the group; colour in summer, much the darkest and brownest. T. l., St. Michael, Norton Sound, Alaska.

poadromus Merriam, in summer, cinnamon brown above, tinged reddish on head; front feet brown, hind white. T. l., Stepovak Bay, Alaska Pen.

labradorius Miller, like *arcticus*, with widespread rami of lower jaw, and very large nasal bones. T. l., Ft. Chimo, Ungava.

Range and Haunts

The range, as set forth on Map XVIII (p. 684), may be otherwise expressed as—the Arctic Fauna, south of latitude 74°. In this great treeless belt, it is found wherever there are dry open plains, variegated with rocky hills.

The favourite haunts of this Hare are the open plains without trees. Though venturing to the very edge of the "Land of the Little Sticks," it never enters the woods. Summer or winter, it keeps to the open, preferring always the low hills that are rocky or strewn with boulders. In low thickets, such as are frequented by the Snowshoe Rabbit, or level, open plains that are so acceptable to the Jackrabbit, we look in vain for the Arctic Hare. Rocks are its specialty in the way of cover, and the rockier the hills, the better it likes them.

"There is scarcely a spot in the Arctic regions," says Ross, "the most desolate and steril that can be conceived, where this animal is not to be found, and that too throughout the winter: nor does it seek to shelter itself

[5] Nat. Hist., 2d Voy., p. xvi.

from the inclemency of the weather by burrowing in the snow, but is found generally sitting solitary under the lea of a large stone, where the snow drift, as it passes along, seems, in some measure, to afford protection from the bitterness of the blast that impels it, by collecting around and half burying the animal beneath it."[6]

In Newfoundland, according to Henry Reeks, it "appears tolerably plentiful throughout the island. [There] it is a thoroughly alpine species, never descending to the plains except when driven to do so in search of food during two or three months in the depth of winter."[7]

Numbers

In the country north of Lake Aylmer, where I met the species in 1907, it was rare, so that in two months, I saw only 3. In the Barrengrounds along the Arctic coast of Canada, Roderick MacFarlane found it so scarce that he secured only 3 specimens during his five years' residence at Fort Anderson.[8]

"These animals are really not so very rare on the Barren Ground," says Stefansson, "as one may see by their traces left on the snow in winter; but in my entire Arctic experience, I have seen only 4 or 5, and have never shot a single one."[9]

So that it is not generally abundant. The only places where it is definitely known to occur in great numbers is in Alaska. On Alaska Peninsula, L. L. Bales found these Hares numerous.[10]

In the flat country around the mouth of the Yukon, Nelson says, "it is numerous in all the open coast country from the mouth of the Kuskoquim River to the Kotzebue Sound district. From this latter point north along the Arctic coast, these Hares are more and more scarce, until in the vicinity of Point Barrow, where they are unknown, according to Mr. Murdoch.

"In the interior, however, wherever open barrens are found along the Kuskoquim and Yukon rivers and to the northward, the Polar Hare is more or less common. On the Bering Sea Islands, they are unknown except on the island immediately adjoining the mainland, such as St. Michaels and Nelson's. The open country of the Yukon delta is their place of greatest abundance, as far as I was able to learn. There, in May, 1879, I found them very common. The snow was nearly gone; and, while travelling along the

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[6] Nat. Hist., 2d Voy., pp. xv, xvi.

[7] Notes on the Zoology of Newfoundland, Zoologist, March, 1870, p. 2045.

[8] Through the Mackenzie Basin, 1908, p. 247.

[9] My Life with the Eskimo, 1922, p. 211.

[10] Outdoor Life, July, 1913, p. 22.

Plate LXXXVI. Head of Arctic Hare

small channels between the islands in the pale twilight which marks the nights at that season, we saw many Hares playing about on the banks. They were often in small parties of from 3 to 5 or 6, and were not very shy."[11]

"This species [*othus*] is fairly numerous on the tundra back of Kotzebue. After crossing the ice of Goodhope Bay, Bailey saw the tracks quite commonly on the south shore of Kotzebue Sound."[12]

Food

The collected remarks of Northern travellers go to show that the Arctic Hare eats the same sort of food as Hares elsewhere; that is, every kind of grass, shrubs, and flowering plant that is found in its haunts; and is especially fond of the catkins, leaves, bark, twigs, and roots of the dwarf willow.

According to Hearne, "In Winter, they feed on long rye-grass and the tops of dwarf willows; but in Summer, eat berries, and different sorts of small herbage."[13]

Lyons writes on Winter Island: "On the 8th [Jan. 1822] a Hare was killed while seeking food on our dirt heap. It was very thin, and weighed 7 lbs. On dissecting, it was discovered that the leaves of the herb-tea which was served out to our people, had been the cause of its frequent visits alongside."[14]

Richardson says: "It seeks the sides of hills, where the wind prevents the snow from lodging deeply, and where, even in the winter, it can procure the berries of the alpine *arbutus*, the bark of some dwarf willow, or the evergreen leaves of the Labrador tea-plant (*ledum*)."[15]

Enemies

Every predaceous bird and beast in the Far North preys on the Arctic Hare whenever it can catch it. Bears, Wolves, Wolverines, Foxes, gyrfalcons, and snowy owls are the natural enemies it is forced to guard against when fully grown; and as a fluffy, helpless leveret, it is the easy prey of skuas and ravens, as well as of Weasels.

The Muskox and the Caribou are the only big land animals that it need not fear. And it seems fully aware of the fact; for Hares will play in and

[11] Alaska, p. 271.

[12] Bailey & Hendee, Journ. Mamm., Feb., 1926, p. 21.

[13] Journey, p. 383.

[14] Private Journal, p. 76.

[15] F. B. A., I, p. 221.

around the herds of these ruminants, possibly realizing that, in the Muskox at least, it may find a guardian from Wolves.

The universality of its enemies has made the Hares amazingly shy. In lands where gunners abound, we expect the game to be the most ready to flee. But the Arctic Hare, living alone, and maybe never seeing a man more than once in a lifetime, is more ready to run than any of its relatives that I have seen. Those that I met around Aylmer Lake, left their forms, and fled away long before I was within gunshot.

Against owls and falcons, the Hare's speed could avail but little. The only safety from them is a thicket of Arctic willow, a cleft rock, or a hole in the snow. It is well to remember that, in the North these birds of prey are found only during summer. If any of them are raiding in Hare-land during April and May, or September and October, the Hare eludes them by hiding all day, moving about only at night. Nelson says that in May at the mouth of the Yukon, he "found them to be almost entirely nocturnal in their habits, rarely moving about in daytime, even during the gloomy days when the sky was obscured by dense, low-lying clouds. Although they are nocturnal in their habits, yet they see very well in the days and it is extremely difficult to surprise one in its form. Usually, it spies the hunter before he gets within gunshot, and leaves the spot in great haste."[16]

In view of these statements, we are confronted by a puzzle—there is *no night* in the true Arctic regions during summer.

Powers and Gifts

Against the Wolf and Fox, his speed is his protection; but be it noted that neither Wolf nor Fox is a very fast runner; it is morally certain that neither of these could run with the Coyote. This, with all other evidence at hand, goes to show that the Arctic Hare is not nearly so speedy as his cousins, the Jackrabbits of the South.

Those who have noted the Northern Indians' horror of the water, and realized that no Eskimo can swim, must be a little surprised to learn that the Arctic Hare swims readily and well. Nelson says that in Alaska during May, "the beds of creeks and other hollows are filled with slush and water, covering the ice below. This water is frequently several feet deep; and in many instances, I saw places where these Hares had come down to the bank, and, judging from their tracks, had plunged in without hesitation, and swum across to the opposite side. Their tracks showed, by the shortness of the jumps as they approached the water, that they were in no way fright-

[16] Alaska, pp. 271–72.

ened or forced to cross. In one case, a stream over 30 yards across, was thus passed by one of these animals."[17]

Form

The form, or, as our own Western folk would call it, the bed, is any smooth hollow of natural make, sheltered by some rock or overhanging stone. It has no lining, and even in the dead of the deadliest winter storm, the Hare considers it comfortable if it shelter him from the direct force of the wind.

There is every reason to believe that, in extreme weather, the Hare allows the snow to bury him as it falls, or will even burrow a little way into it as do some others of the Hares. But so far, no one has recorded it.

Solitary

In the life of the Whitetailed Jackrabbit, it is shown that, though so abundant in places, the Jack is far from being gregarious. The same remarks apply to this Hare. Nelson says:

"During most of the year, these animals are essentially solitary; but during April and May, they gather into small parties, and sometimes as many as a dozen or more may be found on a single hillside."[18]

Mating and Young

The small parties mentioned by Nelson are, of course, the result of the sex-urge; and the inference is that the mating takes place about the first of May. The young, then, should arrive about the first of June; and what little evidence is at hand, shows that in all its doings at this time, the Polar Hare resembles closely its blood-kinsmen, the Common Hare of Europe, and our own Jackrabbits.

The young number commonly 2 to 4, but may be as many as 8. Richardson mentions the interesting fact that "a nearly mature foetal specimen was of a blackish brown colour on all the upper parts and outsides of the extremities."[19]

Similar testimony comes from J. C. Ross. He says: "A female killed by one of our party at Sheriff Harbour [Boothia Peninsula], on the 7th of June, had 4 young *in utero*, perfectly mature, $5\frac{1}{2}$ inches long, and of a dark

[17] Alaska, p. 272.

[18] As above.

[19] F. B. A., I, p. 224.

Plate LXXXVII - Feet of Arctic Hare. 1/1

gray colour. In one shot by us in Igloolik, on the 2nd of June, 6 young were found, not quite so far advanced.[20]

On the Arctic coast, near Bathurst Inlet, June 10th, D. T. Hanbury's party secured a Hare that "in a fortnight would have given birth to 5 leverets."[21]

The young are found among the stones of the old Hare's favourite haunts. No one as yet has reported on the nest, so we must suppose that, like its relatives farther south, it makes none.

It is evident that there can be but one brood a season.

Tamable

If taken at this early age, the Arctic Hare, like its European cousin, is quite tamable. Nelson writes: "During one winter at St. Michaels, my friend, Mr. Rudolph Neumann, had one of these animals for a pet. It was kept in the dining room at the fort, and became quite domesticated. It was very mischievous, and would sit up before a person and beg for food; and if ignored, would attract attention by striking one's legs with its fore paws. Owing to being teased, it finally became ill-tempered, and would strike one's hand a painful blow with its fore foot when displeased. Eventually, it came to a tragic end, as seemed to be the fate of all pets reared about the Fort."[22]

A still earlier and perhaps more interesting case is given by Capt. J. C. Ross. "One taken by us," he says, "on the 28th of June a few days after its birth, soon became sufficiently tame to eat from our hands, and was allowed to run loose about the cabin. During the summer, we fed it on such plants as the country produced, and stored up a quantity of grass and *astragali* for its winter consumption; but it preferred to share with us whatever our table could afford, and would enjoy pease soup, plum pudding, bread, barley soup, sugar, rice, and even cheese with us. It could not endure to be caressed, but was exceedingly fond of company, and would sit for hours listening to a conversation, which was no sooner ended than he would retire to his cabin: he was a continual source of amusement by his sagacity and playfulness, until in the middle of winter, when playing some of his pranks, he struck his head against one of the beams, and was ever after, subject to fits. He lived and thrived nevertheless throughout the winter, and died in the following summer after 15 months' confinement."[23]

[20] Nat. Hist., 2d. Voy., p. xvi.

[21] Sport and Travel in the Northland of Canada, 1904, p. 161.

[22] Alaska, p. 272.

[23] Nat. Hist., 2d Voy., p. xvi.

Not much blessed with brains is Ookalik, if we compare him with Fox or Wolf, but shows a lovely harmlessness. He will not bite, even in self-defense. Mild is he as his big, soft, liquid eyes; and if he be taken young—so young that he has not learned the bitter lesson of Man's inhumanity—his native gentleness appears, as we have seen, and shapes his every way.

Hunting

Shy though this creature be, "it is not difficult to get within bowshot of it," says Richardson, "by walking round it, and gradually contracting the circle—a method much practiced by the Indians. In the late boat-voyage along the northern coast, we landed on a rocky islet, off Cape Parry, which, though not above 300 yards in diameter, was tenanted by a solitary Alpine Hare. The whole party went in pursuit of this poor animal; but it availed itself so skillfully of the shelter of the rocks, and retreated with so much cunning and activity from stone to stone, that none of us could obtain a shot at it, although it never was able to conceal itself from our search for more than a minute or two at a time."[24]

The Eskimo, neglecting no chase that promises meat, sets snares for the Hare, and hunts it with arrow and bow. At least, he did at one time. Now, it seems, he has adopted the white-man's weapons and the white-man's way. He hunts the Hare exactly as we do the Whitetailed Deer. He tracks it in the fresh snow, and shoots it on the run, when it springs from its lair—that is, if he can get near the Snow-child. Usually it takes alarm at the sinister approaching form and "starts off at a run before the hunter gets within gunshot, and the latter follows at a slow trot upon his snowshoes. This is frequently kept up for a half dozen miles, or perhaps more, until the Hare becomes exhausted, and finally allows the hunter to get within easy range and secure the prize. At other times, the hunter's breath is exhausted first, and he returns home minus the Hare. I may say that this was usually the writer's experience."[25]

His Way of Life

Autumn must be a happy time for Ookalik, the great White Hare. The snowy owl and the falcon are gone; or, if they linger, there are long dark nights in which the Hare can go forth in spite of them, to feed and frolic. The Wolves and Foxes are well fed on small stuff, such as Mice and Lemmings, or on young Caribou; they are too fat to run, and too unhungry to

[24] F. B. A., I, p. 222.

[25] Nelson, Alaska, p. 272.

try. There is just enough frost for a pleasant tang, and these to the Arctic Hare are halcyon days.

But the ever-deepening snow and fiercer frost are bound to put his endurance to the test, when the Long-Night Moon, the Christmas Moon, is over the broad, white land. Now the Wolf and the Fox are hard pressed for food. Now are they in hunger-trim and training, and the White Hare dare not sleep in a hole. He must be ready at any moment, to make a clean dashaway when the faint warning sound of foot-craunched snow is caught by those big, wonderful ears—double-sensed, tuned and keen as much for vibration as for sound. His bed is out on the open stretch where the Arctic blizzard bites the hardest. But the blizzard he loves not, any more than you or I; and in the severest winter weather, he seeks the friendly cover of willow thickets on hillsides, alder patches in sheltered ravines, or in other comfortable situations. But in all other times of Arctic fine weather—that you or I would consider a frightful frost with stinging wind—he lives content and safe on the wide and windswept plains of desolate snow—the only vital thing, perhaps, to tell the traveller that this is not wholly an abode of death, that Nature has equipped at least one warm-blooded, bright-eyed being to live and prosper in the Realm of Old Jack Frost.

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LIFE XCIV—GREENLAND HARE

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Greenland Hare, Polar Hare, Glacier Hare, Great White Hare, Alpine Hare of the Danes, White Wool Rabbit, Swansdown Hare

Lepus groenlandicus Rhoads

(L. *Lepus*, a Hare; *groenlandicus*, of Greenland)

Lepus groenlandicus Rhoads, 1896, Amer. Nat., XXX, March, p. 236.

Type Locality—Robertson Bay, N. W. Greenland

In general, distinguished by its great size—largest of all our Hares, except, perhaps, *Othus*—and by being white the year round.

Size. Length, 26¼ in. (666 mm.); tail, 2⅞ in. (73 mm.); hind foot, 5¾ in. (146 mm.); ear from notch in dried skin, 3 in. (76 mm.).

Weight. 7 to 15 lbs., with an average, according to Manniche, of 8 lbs.; that is, this Hare is larger than an Arctic Fox.

Colour. In winter, entirely pure white, except the small, jet-black tips to ears, and the dark eyes.

In summer—that is, mid-May to mid-August—white, but tinged with dusky gray on ears, head, and back.

The young in first coat are brownish buffy or grizzled above, reminding one of their cousins farther south. By the end of August, they are in pure white like the parents.

The sexes are alike.

Fur

When we come to describe the coat of the Polar Hare, we are forced to look around for a new vocabulary. It is not like anything else that is known in the world of Rabbits. The Kansas Jackrabbit has a coat of rain-hair, under which is a slight undershirt of heat-retaining wool; the Mountain Goat has an undershirt of thick, warm jaeger flannels, with an overcoat of rain-deflecting, angle-placed, wind-defying hairs; a young swan is protected with a dense, unbristled down. But the snow-born child of the Polar realm combines all three. He is covered from head to foot, the whole year round, in a deep, dense, wind-proof, snow-proof, cold-proof coat of hair and cot-

ton-wool. To a casual glance, it looks like swansdown; but it has the body, the strength and many other qualities of pure, white wool.

"Amongst the inhabitants of Greenland," says J. C. Ross,[1] "one Esquimaux woman was found who spun some of the beautiful white wool of the Hare into a thread, and knitted several pairs of gloves; one pair of which, notwithstanding the native filthiness of the Esquimaux, came into my possession beautifully white. It very much resembles the Angola wool, but is still more soft."

The nursery fringe or excessive growth of long, silky hair on the lower belly, is well developed—over 3 inches long—and is pure white at all times.

In the spring moult, we learn from Manniche that "the Hares free themselves from loose tufts of hair by rolling in the frozen snow."[2]

Peculiarities of Form, Etc.

Anatomically, as Nelson says, "this is one of the most strongly differentiated forms among the known Arctic Hares of America. Its excessively heavy, wool-like coat of fur, the great development of the claws, and the remarkably long, tapering upper mandible, with the extremely long, extended, slightly curved upper incisors, are characters not approached by any of its known relatives on this continent. . . .

"The stout fossorial claws and long outreaching incisors of this species are evidently developed to assist in obtaining food in a region where the extreme rigours of a high Arctic climate and the dwarfed vegetation on land hard frozen and covered with ice and snow so large a part of the year, make it difficult for rodents to maintain themselves."[3]

These are well-marked specific characters, so, of course, are seized on and used by the extremists as the basis for a new group—subgenus at present but in time a new genus. The museum-mad splitters who follow this fetich are the enemies of zoology; they rob classification of all significance. The logical finish of their mode—and they are rapidly nearing it—is a separate genus for each and every species.

Range on Land and Sea

In brief, the range is all of Greenland outside the glacial-cap, and all of the Canadian Islands north of latitude 74°, where there is land free of ice. The following interesting records are in detail of the above.

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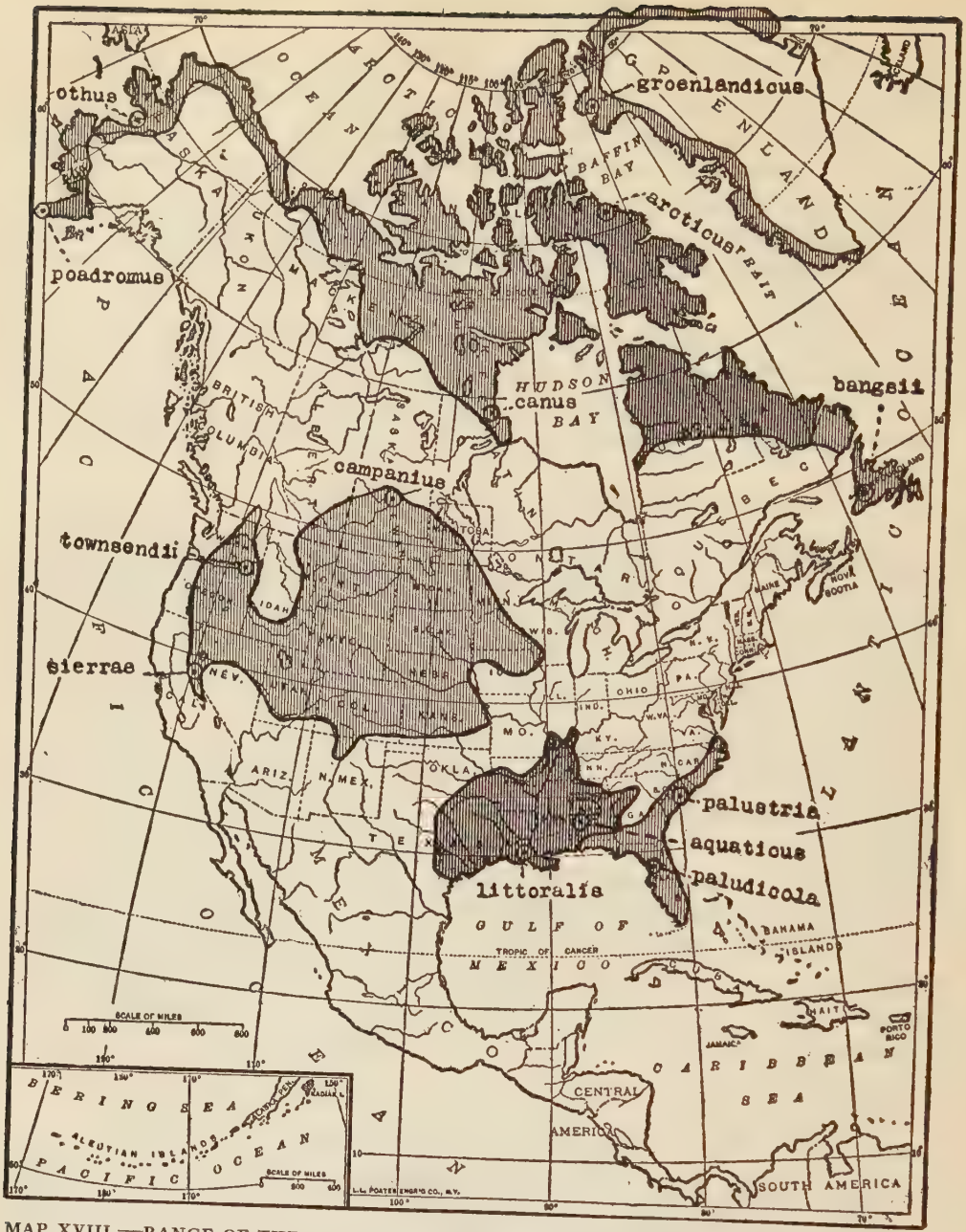
[1] Nat. Hist., 2nd Voy., p. xvi.

[2] N. E. Green, p. 34.

[3] Rabbits of N. A., pp. 68–69.



MAP XVIII.—RANGE OF THE GREENLAND HARE, OF THE ARCTIC HARE, AND ITS RACES; OF THE PRAIRIE-HARE AND ITS 3 RACES; OF THE MARSH RABBIT AND ITS 2 RACES; OF THE SWAMP RABBIT AND ITS 2 RACES

By E. T. Seton, with assistance of the Biological Survey, 1927

Kane says: "We have traced it from Littleton Island as far north as 79° 08′."[4]

Peary found Arctic Hares in North Greenland.[5]

Rasmussen says: "Very numerous" on the north coast of Greenland.[6]

Greely found it common in Grantland, which is the north part of Ellesmere Island, lat. 82°.[7]

Melville Island, Capt. F. L. McClintock got 3 Hares; on Prince Patrick Island, 1; on Emerald Island, 0.[8]

Manniche writes: "This species may—according to existing reports—be considered of comparatively scarce occurrence on the east coast of Greenland, south of 76° lat.";[9] but northward and northwestward, it is plentiful. "Even on the small rocky islands farthest out at sea, as, for instance, Maroussia [5 kilometres from the mainland] and the outer skerries, I [Manniche] found traces of the Hare, showing that they reach these places over the ice; a Hare was shot on Maroussia, Feb. 27, 1908."[10]

Abundance

It must give every naturalist a joyful thrill when he realizes the abundance of this fine Hare in most of its accredited region. Egede, writing of the species in Greenland (1741), says: "There are also vast numbers of Hares."[11]

Apparently, however, they were overdrawn on; for some hundred years later, Dr. Henry Rink says: "Of the White Hares, hardly 1,000 are taken each year in Greenland."[12] This, of course, refers to the old Danish settlements where they had been "over-cropped"; but farther north, more primitive conditions prevail, and the species is numerous. Thus, Donald B. Macmillan writes, Sept., 1915, 45 miles below Etah: "The green grass at Nerky was fairly dotted with the white bodies of 29 Arctic Hare. Jot squatted on the shore, and, resting his elbows on his knees, killed 5 before they decided that he was dangerous."[13]

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[4] Arctic Explor., I, p. 395.

[5] Northward Over the Great Ice, 1898, I, p. 490.

[6] Greenland by Polar Sea, p. 298.

[7] 3 Years, pp. 147, 238, *et. seq.*

[8] Voy. of Fox, 1860, acc. to T. R. Jones, Manual Nat. Hist., Greenland, etc., 1875, p. 498.

[9] N. E. Green., p. 26.

[10] As above, p. 27.

[11] Desc. Green., p. 68.

[12] Dan. Green., 1877, p. 106.

[13] Four Years in the White North, 1918, p. 101.

On the north coast of Greenland, Rasmussen found it "very numerous," "common everywhere," so plentiful that "in the course of a couple of hours, no less than 8" were taken.[14]

On Melville Island, the Polar Hare has always been abundant. On Aug. 15, 1820, Dr. Alexander Fisher "returned in the evening, after a few hours' excursion, with 9 Hares."[15] Aug. 17—"Mr. Fisher was again successful in his sporting excursion bring in 9 Hares, the greater part of which were still beautifully white,"[16] probably meaning that they had been white all summer.

Captain William Edward Parry makes the following summary: "The total quantity of game obtained for the use of the Expedition during our stay upon the shores of Melville Island, being a period of nearly 12 months, was as follows: 3 Musk-oxen, 24 Deer, 68 Hares, 53 geese, 59 ducks, 144 ptarmigan; affording 3,766 pounds of meat."[17]

Captain George F. M'Dougall, who also wintered at Melville Island, announces the following: "Game List, from 3 Sept., 1852, to 9 Sept., 1853. Muskoxen, 114; Reindeer, 95; Hares, 146; Bears, 6; Wolves, 3; Foxes, 51."[18] In both cases, it shows that the Hare was the most abundant of the quadrupeds.

According to Manniche, "the Alpine Hare proved to be very common in the regions which were explored by the 'Danmark Expedition'; at certain places, it occurred indeed so abundantly that it became of economic value for the expedition.

"Besides the considerable number of Hares, which were shot and eaten during the sledge-voyages, not less than some 400 Hares were brought home and consumed on board the ship during the two years it was bound in the ship's-harbour, in the very neighbourhood of which nearly half part of them was secured. . . . At certain seasons, it was by no means seldom to meet with flocks containing 10 to 15 individuals."[19]

McClintock, and Parry too found them in such numbers on Melville Island that they were a godsend; for the flesh is good eating, with little waste and no danger involved. Greely's party had frequent cause to be thankful that Grantland fell within the range of the great White Hare.

This was on the northeast side; but in Oscar Land which is the west side of Ellesmere Island, Sverdrup, in 1900–01–02, found them so abundant

[14] Greenland by Polar Sea, p. 169.

[15] Parry, 1st Voy., 1821, p. 250.

[16] As above, p. 253.

[17] As above, p. 257.

[18] Voy. of Resolute, 1857, App., p. 529.

[19] N. E. Green., p. 26.

as to remind one of the Jackrabbits in California—a prevalence due, apparently, to the absence of Wolves, Foxes and birds of prey. Details of his observations are given under the section on Sociability.

This condition seems to prevail in all of the Far North. In the extreme northeastern part of Greenland, Rasmussen found the species so abundant that it "played an important part as food for the expedition."[20]

As we go westward into more primitive regions, where the Wolf is rare or unknown, we find the Hares increasing. Dr. E. Bay, who explored the west coast of Ellesmere Island with Sverdrup, says of a certain inlet: "We named the fjord 'Harefjord,' and not without reason. Almost wherever we looked, we saw Hares scampering in all directions. The place was teeming with them. They ran about as if they had taken leave of their senses. It was in the midst of the pairing season, and we supposed they had lost their heads from love. It is a thing which happens to others besides Hares."[21] This was at Blaafjeld, i.e., Grantland on Greelyfjord, about lat. 81, long. 85.

But the most colourful description of the amazing flocks of these snow lambs, is found in Sverdrup's account. He was on foot, exploring along the west coast of Ellesmere Island in 1902; and says:

"I now put on my ski, and set off as hard as I could for camp. Round about me, both before and after I passed the narrow canyon, the slopes were swarming with Hares which were out foraging. When I reached camp at about half-past 7 in the evening, I found the Dogs hard at work gnawing some frozen meat which they had been given. They had made a clean sweep of everything else in the morning.

"I drove on next day at our usual time; again passed the herd at about the same place where I had seen it before, and [we] were soon down through the narrow canyon, although now and again we had to put ourselves, all four, to the sledges to bring them across the stony ground.

"A little farther on, we drove past a Polar herd on the other side of the valley. Some of the animals were standing on the precipice; others were climbing up and down the steep stony slopes, looking like flies on a wall. When we were right under them, they formed up on the precipice, and stood glaring down at us.

"It might be thought that in a country like this, teeming with both ground game and big game, there would also be a great number of beasts of prey, but this was by no means the case; neither in Vendomfjord nor on Troldfjordeidet did we ever see the track of a Wolf. Indeed, everything indicated that the latest "Wolf period" existed in times far back. If ever a new

[20] Greenland by Polar Sea, p. 298.

[21] New Land, II, pp. 366–67.

immigration takes place, they will very soon reduce the edible game up here. All these Hare tracks were one of the most extraordinary things I had ever seen; never could I have imagined that their pads would be capable of making such enormous runs.

"The farther we went, the more numerous were the Hares; and later in the afternoon, when we reached the lower valley, they seemed to be conjured forth from the slopes as if by magic. There were such legions of them, and they scurried about so in all directions along the valley, and backwards and forwards across it, that the Dogs became absolutely unmanageable. It was impossible to keep them in check; they gave chase time after time; and the Hares themselves were so dazed that they had not the wit to keep out of the way. They did not appear to be afraid; they hopped about only a few yards in front of the teams. At last, after the Dogs had bolted after them time and again, we finally landed in the steep bank of a river. It was impossible for the Dogs to drag the sledges up on to the grass at the top; but as each team was determined to pass the other, the end of it was that the whole caravan stuck fast, sledge by sledge, under the top of the bank, the Dogs themselves just managing to reach the grass. There they sat down on their haunches, and let the sledges dangle down the bank.

"As if to incite the Dogs to the utmost, the Hares came and settled down a few yards from them, and then stood on two legs and stared at us. The Dogs yelped and snapped and made a shocking clamour—and the Hares? They never moved from the spot! What were we to do with them? We had shot quite as many as we wanted to eat, and had no wish to destroy them uselessly, but they had to be got rid of somehow.

"We made up our minds to raid the valley, and clear these tiresome vagrants from under our feet, for it was impossible to drive with the country swarming with them in this way. After a good deal of trouble, we succeeded in driving away the greater number, and were able at last to go on."[22]

As all the Hares are subject to great ebb and flow of population, these various records may have been made at a flood time, and therefore do not give an exact idea of numbers. Doubtless, there are areas, as well as years, in which the species is comparatively scarce.

Home Land and Migration

We have no evidence, except that of analogy, on the home range of the individual. It is probably a mile or so across, as is the case with its near kin of similar size.

[22] New Land, II, pp. 181–82.

There is nothing of the nature of true migration among the Hares in general. Millais credits the Mountain Hare (*L. timidus*) of Scotland with quitting the wintry hills to take refuge in the lowlying lands that had more sheltering cover, most of them returning in the spring.[23] In this small and local sense, the Arctic Hare also seems to be migratory. Sverdrup says of the abundant Hares in western Ellesmere Land: "I am inclined to think that it is very usual for the Hares in these tracts to flock together, and change their grounds in the winter months."[24]

Manniche, who studied the species on the northeast coast of Greenland, says: "According to my experience, the Alpine Hare does not undertake real migrations. The Hares which lived in the fells near the ship's-harbour, were nearly stationary all the year round; only in winter, they undertook short excursions to the shore or to adjacent isles, from which they returned sooner or later";[25] migrating over the ice to and from these skerries or rock islands only during the hardest time of winter.

Haunts

According to Manniche,[26] the Polar Hare is a frequenter of rocks, and usually is found on mountain slopes. Only in the severest time of winter weather, when in search of food, does it venture to leave its uplands and descend to the shore-plains. Here the meadows and marshes are partly free from snow, and it can find food; but in case of attack, or when seeking rest, it is ever ready to return to the safety of the rocky hills.

Food—Flowers and Ices

The plains of the North, despite the gloomy pictures conjured up by the word, are lovely with flowers and grasses; so that, during the summer, the Polar Hare has a large and alluring list of foods. Of these, the Arctic willow (*Salix arctica*) is the favourite; but saxifrage (*oppositifolia*), dryas, and rubus are among the staples. However, Manniche relates that a captive Hare would eat white bread, but refused all the plant food offered, except salix and saxifrage as above.[27]

Parry says that on Melville Island, Aug. 11, 1820, "we remarked that almost the whole of the plants had a part of their flowers cropped by the

[23] Mamm. Gt. Br. & Ire., 1906, III, p. 36.

[24] New Land, II, p. 46.

[25] N. E. Green., p. 36.

[26] As above, pp. 28–29.

[27] As above, p. 33.

Hares and other animals which are fond of feeding in the sheltered and warm situations afforded by the banks next the sea."[28]

Its favourite foods seem to be the roots and stems of the arctic willow, as we have noted. Manniche describes its mode of securing the roots:

"When, in the afternoon, the Hare begins to feel hunger, it slowly leaves its resting place after a violent yawning and stretching of the limbs; the hungry Hare makes a few indolent jumps forwards on the hill side, and then begins to snuff and scrape for food. This consists essentially of the subterranean, juicy stalks and roots of *Salix arctica*, which the Hare highly appreciates. The animal may, therefore, often be seen busy getting this food, when the earth is thawed up.

"I have often, at a distance of but a few paces, witnessed this interesting work. The Hare selects, by means of the nose, the most promising place; and then goes to work scratching away the upper layer of earth, using its fore limbs with a surprising skill and vigour; thereupon, it makes its way—by means of its nose—to the desired delicacy which it triumphantly hauls up, sometimes in pieces of some 20-30 cm. length.

"Now the Hare sits with a dignified air and half closed eyes—evidently envied by its surrounding companions—enjoying the juicy meal, the long-moulted willow root still hanging out of the mouth like a cigar.

"The energetic masticating motions could distinctly be heard like a weak rustling. Soon the last rest of the willow root disappears, and the Hare again begins to search and snuff; but first it removes the dirt from its muzzle, either by aid of the forepaws, or by rubbing it against the turf or a clump of snow. . . .

"The Hares slake their thirst by taking a mouthful of snow now and then."[29]

Food in Winter

In the winter, although food is still there, the difficulty of finding it is much increased. Here is where the strong, projecting teeth and well-armed paws are of service.

Dr. Kane says of the Hare: "Its structure and habits enable it to penetrate the snow-crusts, and obtain food where the Reindeer and the Muskox perish, in consequence of the glazed covering of their feeding grounds."[30]

In amplification of this, Manniche says: "Crusted snow, through which the Hare is not able to penetrate with the fore legs or the nose in usual way,

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[28] 1st. Voy., p. 244.

[29] N. E. Green., pp. 31–34.

[30] Arctic Explor., I, p. 395.

is forced in the following manner: Having first—by aid of its surprising sharp sense of smell—assured itself where the food can be found, the Hare hammers its fore limbs against the snow crust in rapid, strong beatings, until the crust breaks all over. The animal can then, by aid of its nose and nails, remove the subjacent loose snow, and get at the desired food."

He continues: "I have also seen Hares which, having drummed through the icy snow crust, remove larger pieces of broken ice by means of the mouth, in order to make better room to go on with their work.

"The peculiar sound which the Hare produces by the said beating or drumming against the snow crust, reminds you of distant rolls."[31]

That it makes a continued success of its food hunt is indicated by Greely who, commenting on the 11-lb. Hare which he secured on Grantland (north Ellesmere), says: "Its excellent condition showed that, despite the severity of the weather [15 Feb.], it had found sufficient and satisfactory food, principally buds of the *Saxifrage oppositifolia*."[32]

When other winter foods are scarce, it must, according to Manniche, "be content with moss and withered grass."[33]

Whether it eats the lichen also is not set forth; and so far, it has escaped all charges of carrion-eating, or of cannibalism.

Mating and Young

The pairing time is given by Manniche as April and the first days of May. He says further: "More or less developed embryos could be found from ultimo May till the middle of June—in a few animals some days later.

"The number of embryos was, as a rule, 6, seldom 5 or 7."[34] Fabricius[35] records 8 in intero. Feilden also mentions a female which "contained 8 young ones." [36]

Manniche continues:[37] "One animal, shot at 'Stormkap' on May the 31st, and, as far as I could judge, a very old one, contained but 2 embryos.

"The . . . Hare, which was caught on April the 30th, died on May the 28th. . . . The animal contained 6 rather developed embryos.

"Leverets of the size of Rats were seen by Lundager on June the 26th

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[31] N. E. Green., p. 33.

[32] 3 Years, p. 147.

[33] N. E. Green., p. 33.

[34] As above, p. 34.

[35] Fauna Groenlandica, 1780, p. 25.

[36] App. to Nares' Voyage to the Polar Sea, 1878, II, p. 204.

[37] N. E. Green., pp. 34–35.

at 'Snenaes'; he said that the colour was bluish gray. July the 12th and 13th, I shot two Hares respectively at 'Thermometerfjeldet' and 'Harefjeldet'; both the animals had still plenty of milk in their teats.

"The young Hares were still of a remarkably smaller size than the old ones; their weight was only 6 to 7 pounds (Danish); while the average weight of the full-grown was a little more than 8 pounds."

Of course, the species breeds but once a year.

Garden of Eden Simplicity

In the land of the Polar Hare, mankind is virtually unknown. We are not surprised, therefore, to learn that "this species was incredibly fearless in almost any season of the year,"[38] according to Manniche. And, further, the flocks of Hares were so confiding "that they—by a proper mode of proceeding—could be treated just as tame animals.

"Thus, I could every day—on the before-named 'Harefjeld' in the neighbourhood of the ship's-harbour—go among the Hares as among a flock of Pigs; I could touch them with the tips of my fingers, get them to eat a willow root, which I held out to them, catch them in a catcher, let them loose again after having kept them in my hands, catch them again a.s.f. all provided, that I did not frighten the animals or make then uneasy by my arrival or by a sudden noise or quick movement. . . .

"If the Hares had once become confident in my presence, they did not care for it later on, and I could make every kind of noise in their presence. I even tried to fire a shot, but this did not impress the Hare flock much; only those individuals which were occupied by chewing, stopped their activity for some few moments."[39]

In apparent contradiction to this is his statement that in "June and July—when the fells are quite bare of snow, and the white animals fully deprived of their natural protection, the Hares showed at this season a remarkable fear of human approach, and sometimes they were so shy, that one could not get them within rifle range."[40]

So also, Dr. E. Bay, who was the zoologist of Sverdrup's expedition, says: "Its behaviour varies much; as sometimes it will allow one to approach quite near to it, while at others, it is a matter of difficulty even to come within reasonable rifle range."[41]

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[38] N. E. Green., p. 28.

[39] As above, pp. 33–34.

[40] As above, p. 33.

[41] New Land, II, App. III, p. 478.

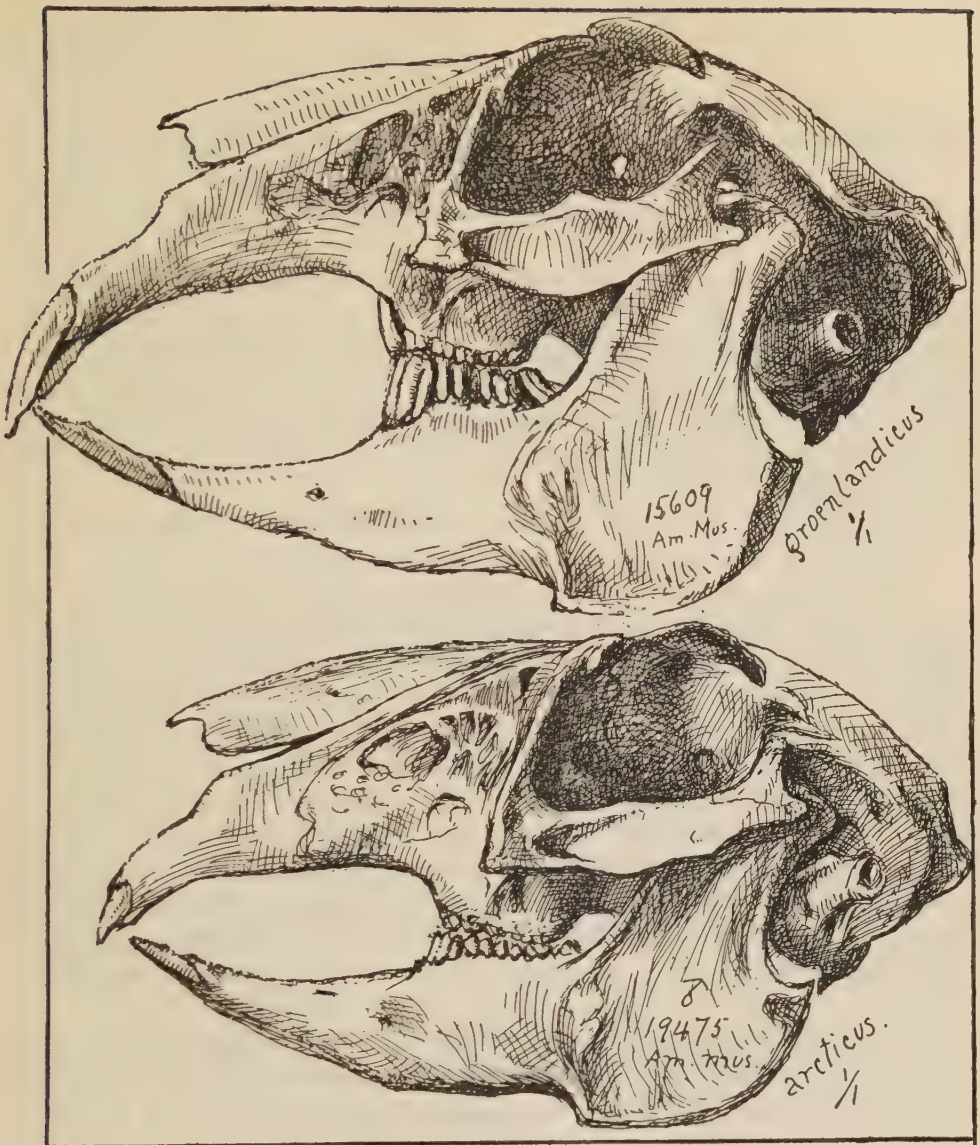

Plate LXXXVIII. Skulls of Hares.
from specimens in American Museum.

Sociability and Voice

More than any other Hare on this list, the Polar Hare is sociable. Thus, Manniche says that its strongly developed sociability is a characteristic of the species. He speaks of Hares assembled in parties of 15 to 20 individuals; and adds that, although in summer, they become shy, they do not lose the sociable impulse.[42]

Sverdrup writes on North Kent Island, between Aug. 14 and 24: "While we were lying to offshore in this way, I one day saw a herd of animals which I thought were Reindeer. . . . but later on, I came to the conclusion that they must have been Hares. At that time, we were not aware that the Hares in these tracts sometimes congregate together in numbers. In this case, there were some 60 or 70 of them, or possibly the number may have been nearer 100. . . .

"Many times afterwards, we saw numbers of Hares together, sometimes in the autumn as many as 30 animals at once."[43]

"On April 27th, on west side of Ellesmere Land [about lat. 79°]," he says, "as I was walking slowly down the slope, I saw a score or so of Hares, sitting nibbling the grass on a little stony hill. I made my way very slowly down towards them, just to let me see how near they would let me come. They soon caught sight of me, and slowly collected. At last, they became an unbroken white mass at the bottom of the hill, where they arranged themselves with their heads inwards and their tails out. There were so many of them that there were several rings, one within the other; and it was a life-and-death matter to be in the most inmost ring—at least, so it appeared to me, for they made the greatest commotion about it. They pushed and fought, and bit each other, till they screamed aloud, all the time slowly revolving, something like a millstone. This was the square of the Arctic Hare.

"After I had watched them for a while at 10 or 12 paces, I turned off round them in order not to frighten them quite out of their wits; and, after I had gone a little way, I saw, on looking back, that they had begun to disperse about the hill, and were browsing again."[44]

By all the rules, a sociable animal should be very vocal; and yet it seems that the Polar Hare utters the same cries as the European Hare—no more and no less; that is, it screams when in dire peril. Possibly it utters

[42] N. E. Green., p. 33.

[43] New Land, II, p. 46.

[44] As above, pp. 178–79.

a "*qua qua*" when fighting; and the mother may have a soft, murmuring sound when calling her young.

As to its mode of expression, we may repeat Manniche's observations as follows: "Sometimes the grazing animals would snarl at each other, and lay the ears backwards just as snappish Horses.

"At one place, male and female were sitting, licking and scratching each other with their fore paws until they were disturbed by their companions, which were sitting or jumping around."[45]

All sociable animals have games. To this rule, the Polar Hare apparently conforms; at least, the following looks like a game. Manniche says: "While the Hares were searching for food on the side of the fell, or in the more luxuriant ravines, they executed the funniest plays. Sometimes one pursued another a long way on the fell, until the pursued Hare at last performing a high jump, dropped down just behind the pursuer, and then hastened back to the flock."[46]

Enemies

"In N. E. Greenland, the full-grown Alpine Hares have, according to my experience, but few enemies to fear. (See *Canis lagopus*, *Canis lupus* and *Nyctea nivea*)."[47]

Condensing many accounts, there seems little doubt that the chief foes of the full-grown Polar Hare are White Bears, White Wolves, and White Foxes. The Wolverine does not figure, because he does not enter the range of the Polar Hare.

The young have a longer list of enemies. In addition to the above mentioned, Ermines, snowy owls, and ravens are forever taking their toll of the helpless young.

Strange to add, man, the destroyer, is last on the list—not because he is ever restrained by any feeling of compassion or by lack of power, but because he simply never, or almost never, gets a chance to attack them.

Gait

Reference to the various Jackrabbits of the Plains shows that these creatures of mighty hind limbs commonly shoot up in the air, Kangaroo-fashion, to take a look around—that is, they execute a spy-hop. The Polar Hare does the same, but has gone yet farther on the Kangaroo trail.

[45] N. E. Green., p. 34.

[46] As above.

[47] As above, p. 35.

Observations made by Greely's party in the north part of Ellesmere Island show that this Hare often travels Kangaroo-fashion on two feet. "Sergeant Rice," he says, "hunting on the 20th [Feb., 1882], shot at a Hare, but did not obtain him. He reported that the Hare travelled for a hundred or more yards at a time by jumping on its hind legs, for distances of 6 or 8 feet, never touching the ground with the fore paws. He said that he thought it at first an optical illusion; but the tracks confirmed his eyesight, showing the hind feet only to have touched the snow."[48]

Similar testimony is offered by Manniche. He says of a flock that he scared away: "In rapid jumps, they hurried up the hillside—never the opposite way—moving on the tiptoes of the hind limbs, while the fore limbs either dangled in the air, or were kept close to the breast.

"The vigilant animals danced among each other—still without using their fore limbs."[49]

Senses

Manniche, in effect says: "I feel sure that the Hare in dangers, trust more to their sense of hearing and smelling than their sight. I convinced myself, on many other occasions, that the Hare's sight is not very good."[50] This sounds like a paradox, for creatures of the open usually develop wonderful eyesight.

There is much evidence that the ears are of service as vibration antennae, as well as hearing organs.

Neither Diurnal nor Otherwise

In a land where half the year is day and half the year is night, who can say what makes an animal nocturnal? Manniche approaches this complexity in these words: "Though not exactly a nocturnal animal, the Hare always takes the hours of rest at that time of the day when the sun is at its highest. Yet it will begin a meal even in the middle of the day, if it is wakened up or frightened. In the dark period, it seems to have no fixed time of rest."[51]

Habits

Like all Hares, the big, white, woolly one has a number of forms, in which it finds comfort. They face different ways to meet different slants of

[48] 3 Years, p. 149.

[49] N. E. Green., p. 31.

[50] As above, p. 31.

[51] As above, p. 29.

wind and storm. They are always in a nook that is sheltered from the wind by rock, bush, or grass on three sides.

Manniche, commenting on this, says: "When resting, the Hare generally sits near a large stone or a low wall of rock, dozing or asleep, sheltered from the wind, and if possible, warmed by the sun. Most commonly, it will choose its seat a little way up a slope, not too near the top nor at the foot."[52]

In one direction, the Hare has gone further than its cousins, for reasons that are obvious. Manniche says: "Through large, not too hard snow drifts, formed in winter, the Hare will sometimes dig long tunnels for shelter; but as a rule, I found it even in the severest winter cold, sitting by its stone without any other shelter than what the stone could afford; and with only that deepening in the snow which was caused by the weight of the animal."[53]

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[52] N. E. Green., p. 29.

[53] As above.

LIFE XCV—SNOWSHOE RABBIT

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Snowshoe Rabbit, Common Bush-rabbit, White-rabbit, White-hare, Northern or Varying-hare, Wabasso

Lepus americanus Erxleben

(L. *Lepus*, a Hare; *americanus*, because this was the first American Hare recognized as distinct from those of Europe)

[*Lepus*] *americanus* Erxleben, 1777, Syst. Reg. Anim., I, p. 330.

Type Locality—Hudson Bay Territory, probably near Fort Severn

French Canadian, *le Lapin, le Lièvre d'Amérique.*
Cree, *Wah-poos'.*
Ojibway and Sauteaux, *Wah-boos'*
Chipewyan, *Kah.*
Yankton Sioux, *Mah-steen'-cha.*
Ogallala Sioux, *Mah-stin-cha' la.*

Combined with the generic characters, the Snowshoe Rabbit has marked peculiarities of size, etc.

Size. A male taken at Carberry, Man., Nov. 2, 1886, was 18 in. (457 mm.) from snout to end of tail-bone; the head and body were 16½ in. (419 mm.); the tail-bones, 1¼ in. (31 mm.); hind foot, 5½ in. (140 mm.).

A medium-sized female shot at Carberry, on the date above, was 17⅜ in. (447 mm.) in total length from snout to tip of tail-bone; the head and body were 16 in. long (406 mm.); the tail-bones were 1 1⅞ in. (36 mm.).

Weight. Two small males were each 2 lbs. 4 oz.

The average weight of 7 females, taken at Carberry in autumn, was 3 lbs. 1⅛ oz.; the heaviest was 3 lbs. 8 oz.; the above female weighed exactly 3 lbs.

C. M. Oves, writing of the Pennsylvania form, says: "Our largest weighed 5 lbs. and 4 oz.; and the average weight was about 4 lbs. and 5 oz."[1]

Colour. In summer, the typical Snowshoe Rabbit about Hudson Bay is of a reddish-brown above, more or less peppered with black tips to the hairs, especially on the back; becoming clear pale sienna on the legs, and pure white below generally, as shown in Plate LXXXIX (p.702). The upper

[1] Field & Stream, March, 1917, p. 397.

part of the tail is very dark gray, almost black; the underpart white. The ears are tipped with black behind, and bordered with white in front. (Plate XCIX, p. 756.)

In winter, this Hare is pure white with tinges of brown below the surface, and with the black ear-tips unchanged.

Numerous melanisms, that is black freaks, of this Hare, are on record. I have seen 3—1 in Montreal, 2 in New Hampshire. Thomas Anderson, of Fort Smith, Great Slave River, said that black Rabbits were found in that country. He assured me that such remain black all winter. The Indians avoid killing or meeting these, as it means death to the hunter very soon.

The reverse, a white freak or albinism, is less common. One that I saw in Hine's shop at Winnipeg, was shot near the city in the autumn of 1886. It was everywhere pale buff, and its eyes, as usual in these specimens, were bright pink.

Races

The following races are recognized:

americanus Erxleben, the typical form. T. l., Hudson Bay.

phæonotus Allen, paler and buffier than type, darker than *columbiensis*. T. l., Hallock, Kittson Co., Minn.

bishopi Allen, duller coloured than *americanus*, with short, broad skull. T. l., Mill Lake, Turtle Mts., N. D.

virginianus Harlan, largest and most richly coloured; a rusty brown form. T. l., Blue Mts., N. E. of Harrisburg, Pa.

struthopus Bangs, size of *americanus;* ear, longer; colour like *virginianus*, but duller and browner. T. l., Digby, N. S.

macfarlani Merriam, larger than type, with longer ears; a dusky gray form, darkest of all; black on top of tail, and nearly black on rump; feet white. T. l., Fort Anderson, Mackenzie, Can.

dalli Merriam, like *macfarlani*, but paler and more buffy. T. l., Nulato River, Alas.

columbiensis Rhoads, small; dull buffy gray; top of feet, brown. T. l., Vernon, B. C.

bairdii Hayden, like *americanus*, but more dusky reddish-brown; feet, usually white. T. l., Wind River Mts., Wyo.

cascadensis Nelson, much like *bairdii*, but darker and more dusky reddish cinnamon-brown, with rump more blackish. T. l., Near Hope, B. C.

washingtonii Baird, a small, dark reddish form, with little or no white. T. l., Puget Sound.

klamathensis Merriam, like *washingtonii*, but paler. T. l., Head of Wood River, near Fort Klamath, Ore.

(These remarks refer, of course, to summer coat.)

The first 8 forms may constitute one species. The next 2 (*bairdii* and *cascadensis*) may be another. The last 2 may also become established as a distinct species, remarkable for *not always turning white* in winter.

Change of Colour

The old name, Varying-hare, records the fact that it varies its colour with the season. The seasons, in all its proper country, are of two ground colours—brown for six months, white for six; from this, the Northern Hare takes its cue. All summer long, from mid-April till mid-October, it is a little brown Rabbit. Then comes the snowy cold. The brown coat is quickly shed, a new white coat appears, the snowshoes grow fuller—and the little brown Hare has become the Snowshoe Hare of the Woods.*

Most naturalists have assumed that the fur of the animal actually changes in colour. This is not the case. Dr. J. A. Allen, after an exhaustive study of the subject, has demonstrated[2] that the variation is due, not to a change of colour, but to a moult; the brown coat being succeeded by a new coat of white each autumn; this, in turn, being shed in spring, to be replaced by the brown or summer coat. The changes are as regular as the moults of other fur-bearers, and are not influenced by the weather. The order of change in autumn is feet, ears, sides of nose, front of head, rump, flanks, crown, and last, the back. The order is reversed in spring when the creature turns brown.

The most vigorous individuals are first to change, those that are very young or sickly being a week or two later; these sometimes do not turn completely white.

Dr. Allen makes also the following interesting remarks:[3] "Whether or not the soft underfur is also shed in autumn, cannot readily be determined; but from its increased length and abundance in winter, as compared with summer and early autumn, it is evident that, if not wholly renewed, it at least is greatly augmented.

"In the case of the spring moult, there is little doubt that the whole pelage is renewed, the underfur quite as completely as the overhair.

[2] Bull. Am. Mus. Nat. Hist., VI, pp. 107–28, May 7, 1894.

[3] As above, pp. 120–21.

*Mrs. Edith Darbey, of Winnipeg, writes me, Oct. 15, 1927, that on Jan. 8, 1927, a Snowshoe Rabbit in full summer coat was brought to their taxidermist studio.

PLATE LXXXIX.—SNOWSHOE-RABBIT IN SUMMER COAT

(*Lepus americanus* Erxl.)
From specimen taken at Carberry, Manitoba, in June, 1883

"In the case of wounds from fighting or other cause, resulting in the violent removal of large bunches of fur, it is interesting to note that in the autumn, the new hair comes out white, often weeks in advance of the general change; and that in spring, under similar circumstances, the hair comes out brown, like the summer coat, much in advance of the general change from winter to summer pelage."

Protective Colour

The protective value of their blended tints, and the way in which many animals turn them to account, raises the question: Are they conscious of their adaptation to surroundings?

Dunham Wheeler writes me, Jan. 7, 1901: "Deer seem to realize their colour; they come to the water to drink, and commonly pause to reconnoitre among dead brush that matches their coat. I am sure that the Northern Hare does so; for in the spring of the year, when they are still in white, and when the snow is in patches, they *invariably* squat or rest on the snow."

R. Nichols, of Portland, Ore., assures me that ptarmigan in white always squat on the snow, if the ground be bare in places.

This does not agree with my own observations on Snowshoe Rabbits and White-jacks. Twice I saw a White-jack crouch on a white rock; but I many times saw them when in winter coat, crouch in brownish, grassy places where they were ridiculously conspicuous. On the bare ground, they are, of course, more visible, and here they were very shy; though this might be explained by the absence of cover.

I am not yet satisfied that any animals actually realize the protective value of their colour.

The Snowshoes

The Snowshoe Rabbit, the Wabasso of Hiawatha, is a wonderful creature, the product of a snowdrift crossed with a little Brown Hare. The terror of the Northern woods is—not cold, there are many ways of meeting that—but deep snow. Snow is the fearful menace, snow that covers up the food supplies, that robs the swiftest of its speed, and leaves it at the mercy of the foes that are winged, or otherwise equipped to follow fast and lay it low.

Nature has tried many means of saving her own from the snow-death. One of these is sleeping till it is over; this is the way of the Woodchuck. Another is storing up food, and hiding; this is the manner of the Wood-mouse. Yet another is stilts—the plan that the Moose has adopted. The last is snowshoes. This is the simplest, most scientific, and best—and the plan of the Snowshoe Hare.

The Moose is like the wading bird of the shore, that has stilts and can wade well for a space, yet soon reaches the limit, where it is no better off than a land bird. But the Snowshoe is like the swimmer, it skims over the surface where it will, not caring if there be 1 or 1,000 feet of the element below. In this, lies Wabasso's strength.

Here are the feet of a Snowshoe Hare (Plate XCIII, p. 719) that weighed but 3 pounds; and here also the corresponding feet of its cousin, the Kansas Jackrabbit that weighs 6 pounds. The latter is at the mercy of the hunter in deep, soft snow; the other skims over it so lightly that none can follow far—it scoffs at all pursuit, even as its thick, soft fur enables it to mock at the raving storm.

Range and Haunts

Map XIX (p. 739) shows the range of the Snowshoe to coincide with the south edge of the Canadian Fauna, and the north edge of the Hudsonian. Nevertheless, its chief abundance is in the Canadian. In the Hudsonian, it is less plentiful, and there looks like a mere overflow from the more congenial woods to the south.

Excepting for a slight loss of territory on its southern border in the Alleghanies and in New England, the range of the species is much as it was in primitive times. It is, moreover, increased through introduction into Newfoundland. Originally, it was unknown there; then implantations of the form *struthopus* were made, and now it is exceedingly abundant.

It is essentially an animal of thick cover, the thicker the better, provided there be some open spaces where it can enjoy a sun-bath. Tamarac and cedar swamps, if not actually wet, are much to its taste. Open forests with nothing but big timber make no appeal to it; but dry copses, varied with open glades, and willow thickets so dense that the Fox, the Lynx, and the Wolf have no chance in open chase, are the ideal homes of the Snowshoe Hare.

Home Range

Each individual has, of course, its own little territory in which its life is spent. How large, then, is the home ground of this free-footed ranger? Marvellously small. It varies in size somewhat with the kind of country, but in very thick, brushy woods, I should think it is certainly not more than 20 or 30 acres; in more open woods, perhaps twice as much. Some individuals, I believe, will even pass their lives within a radius of 200 yards, never venturing outside of this, unless hard pressed by pursuit. The circle that a White-hare makes when a hound is on its trail, is usually around its home range, and thus it shows the hunter exactly where it dwells.

On my own land, I had a White-hare, brought from New Hampshire, that spent all summer within a radius of 100 yards, although free of 100 acres of thick woods. It was easily distinguished by its having but one eye. I could count with certainty on finding it on any morning, in one of three "forms" or beds under the brush; in the evening, it was usually feeding in the open, not far off. I never saw it in other parts of the woods, and all attempts to drive it elsewhere were futile; it merely circled about its own corner. The fact that it was maimed may have limited its range; but I think, nevertheless, that it showed the usual habit of its kind.

Another Snowshoe, on my grounds, passed all its life within 60 or 70 yards of a certain rocky knoll. Its tracks in the winter were found only near this; and in the summer, it was never seen far away. As it was the only White-hare in my woods at the time, the observations are reliable. When chased, it merely dodged about this knoll.

In five or six cases, I had Cottontails and White-hares in a wire enclosure of about an acre. They were kept in for a month; then two large gates in their prison wall were thrown open, but they continued to haunt the same place as though still fenced in. If they chanced to run out of a gate, they would go butting their heads against the wire fence in their efforts to get back to their little home ground.

All of this goes to prove that the individual range of the White-hare, like that of the Cottontail, is very small; probably still smaller in summer than in winter.

Numbers

The Hare population of a given area in the Northwest is more variable than that of any other large animal; as the species, more than most others, goes in cycles of multiplication. In some large districts, it increases for a period of years, reaching enormous numbers; just why, is not known, but it is generally believed, that a wave of fecundity sweeps over the race.

But invariably, the year of greatest numbers is followed by a year of plague, which sweeps them away, leaving few or no Rabbits in the land. I should say, then, that Hares were very scarce when there was but 1 to the square mile of woods, and abundant when there was 1,000. I have, nevertheless, seen as many as 10,000 to the square mile.

These periods of increase have been remarked on by every observer in the Northwest. I find the following Rabbit years are on record:

Lake of the Woods region, 1856, followed by plague in 1857.[4]

Upper Assiniboine, 1857.[5]

[4] Prof. H. Y. Hind, Narr. Can. Red R. Expl. Exp., 1860, I, p. 119.

[5] As above, p. 284.

Savanne Portage, about 70 miles west of Fort William, 1858–59.[6]

Northern British Columbia, 1872.[7]

Portage la Loche, 1875.[8]

George Grieve, Winnipeg taxidermist, says that 1884 was a Rabbit year in Manitoba along the Ridge two miles west of Reaburn. There, with three others, he shot 147 in three hours.

"At Shoal Lake and Stony Mountain, Man., Rabbits were very abundant, 1883–84. In the spring of 1885, they were found dead everywhere. I saw specimens that were so sick they could not get out of my way. Their necks were swollen and their ears were full of blue ticks."[9]

Warburton Pike says that the autumn of 1885 was a great Rabbit year on the headwaters of the Athabaska.[10]

Red River and Assiniboine valleys, all the poplar country in the basins of Lakes Manitoba and Winnipegosis, Pembina, Riding Mountain, Duck Mountain, and Turtle Mountain, had a great Rabbit season in the winter of 1886–87; followed by the plague in the spring of 1887.

Around Shoal Lake, 1893–94 was a Rabbit year, according to William G. Tweddell, of Woonona, Man.

In the central part of Manitoba, 1894 was a Rabbit year. Dr. D. A. Stewart of Winnipeg, tells me that in the fall of that year "the Rabbits were so abundant along Pembina Mountain that in a 6-mile drive between Altamont and Miami, I saw 35 along the roadside. They were beginning to whiten, though there had been no snow."

In the fall of 1896, Dr. Stewart says that they were fairly plentiful along the Yellowquill trail south of Portage la Prairie; he saw a number lying dead that year. George Grieve gives similar testimony for the Ridge west of Reaburn.

In 1898, though the Rabbits were not very abundant, the plague appeared among them in Shoal Lake Country.[11]

In the whole Mackenzie River Valley, 1903–04 was a marvellous season for Rabbits; their numbers were incalculable. The plague appeared in Jan., 1904, but did not finish its work for over a year. In 1907, I spent 7 months camping in the region without seeing a single Rabbit.

The year 1904 was, to some extent, a Rabbit year in the pine country

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[6] Hind, Expl. Lab., 1863, I, p. 108.

[7] Prof. John Macoun, Man. & Grt. N. W., 1883, p. 352.

[8] As above.

[9] Dr. J. H. Cadham, personal information.

[10] Barren Ground, 1892, p. 268.

[11] George H. Measham in letter.

PLATE XC.—PHOTOGRAPH OF SNOWSHOE-RABBIT (FROM NEW HAMPSHIRE)
To show complete assumption of white coat before there was any snow

of Eastern Manitoba from Whitemouth to Rat Portage, as shown by these notes from my journal:

April 25, 1904, on the railway 25 miles west of Rat Portage (now Kenora), going Westward. This appears to be a Rabbit year. The snow which still lies on all the shady places is pattered over with their tracks. From the train, I have seen but two or three of the Rabbits themselves. Two were snow white, one was half brown; they were quite conspicuous when sitting on the brown earth. Doubtless a walk in the woods would discover many. The most obvious proof of their presence, seen from the train, is the barking of the brushwood. Wherever a poplar tree has been felled, its top is seen completely barked, the buds and finer twigs devoured. In a less degree this applies also to the birch, tamarac, and willow; their favourite food seems to be the poplar. It is curious, however, that I see few or none of the large standing trees gnawed; the bark near the ground seems less acceptable than that of the fine twiggery. The few standing trees that were peeled were of very small size.

Whitemouth, same day, 11.20 A. M. Though I do not see any Rabbits from the train here, their work is more and more conspicuous. Vast numbers of saplings—poplars, tamarac, black birch, and I think, willows—are barked, evidently done this past winter. I see no Rabbits, doubtless because the country is so wet with spring floods.

Again, going eastward, May 1, 1904. Near the eastern boundary of Manitoba, I saw the first Rabbit. It was now about 6 P. M. During the next 30 miles, I saw in all 38 Rabbits clearly, and close to the tracks. I saw none at all dead, though they would have been conspicuous in the white fur, as the snow is all gone.

As we drew near Keewatin, they were no longer seen; evidently they abound only in a small region about 30 miles across, at the eastern edge of Manitoba.

After this, I saw no more Rabbits until next day in the region along the north shore from Nipigon to Pardee, where, watching for many hours, I saw 5 all told.

All the way from Lake Nipissing to Ottawa I saw but 1.

In September of that same year, I returned to Ingolf with Dr. Gordon Bell and Dr. J. H. Cadham to investigate the supposed plague; but was much disappointed to find how scarce the Rabbits were. In twenty-four hours, we saw 20 odd alive, found 6 dead in the woods, and 6 dead on the railway. This was not enough, however, to prove that the recent scarcity was caused by epidemic. Those taken showed no sign of disease, although

thoroughly examined by my two medical friends. In western Manitoba, this same year, they were very scarce.

J. Dewey Soper records that in northern and western Alberta, 1912 was a Rabbit year. On a tract of about 30 acres, he found hundreds of Rabbits. Also, that 1916 was a Rabbit year about Sudbury, N. Ont.[12]

Walter McCoy who camped on the Athabaska with two other trappers in 1913–14, gives a glimpse of Rabbit-year conditions. The men wanted about 500 Rabbit skins to make blankets. He says: "We killed most of them in the door yard—as they came from at least half a mile to a mile around to feed on the tree tops and brush that we used in house (?) building. We could kill 15 or 20, and by the time we had those skinned and the hides cut into strips, there would be as many more again waiting. . . . There were literally millions of Rabbits, so there was no need to save them. They would all die off anyway, and were so thick that they were a veritable pest."[13]

These are the generalizations that may safely be drawn:

A Rabbit year in one part of the country is not necessarily a Rabbit year in another, the condition being local.

An abundance of Rabbits is accompanied by an abundance of birds and beasts that prey on them, especially of Lynxes; and yet the destruction by these enemies makes no perceptible difference.

The Rabbits are wiped out in a single spring by epidemic disease, or diseases, usually characterized by swelling of the throat, sores under the armpits and groins, and by diarrhœa.

The denser the Rabbit population, the more drastically is it ravaged by the plague. Apparently, none are left in the year after the most marvellous abundance.

The Great Rabbit Year

In the spring of 1882, when first I lived at Carberry, Man., I could find, perhaps, 2 Rabbits in three or four hours' tramping through the woods. In 1883, they seemed no more plentiful; in 1884, one might see a dozen or more in a morning's walk; in 1885, they were perceptibly more numerous. But 1886, though not a Rabbit year at Lake of the Woods, was the greatest ever recorded in the Western country. The area of abundance began 30 or 40 miles east of Winnipeg, and included all of the poplar country west and northwest of the city, that is all the southwestern half of the Province, excepting the open plains. The abundance that year was prodigious. It so hap-

[12] Journ. Mamm., May, 1921, pp. 102, 104.

[13] Personal letter, Dec. 3, 1915.

pened that the snow was late in coming (November); yet promptly in October the Snowshoes donned their winter garb of white. So here was the vast brown country speckled and dotted, streaked and crawling, with snow-white Rabbits in myriads. Wherever you looked in scrub lands, it was the same. W. R. Hine wrote me: "In October of this year on the Stinking Water, I killed 75 Rabbits in two hours. I could have killed 500 in a day."

At Carberry, they were even more plentiful. At no time were the near bushes without two or three twinkling ghosts of Bunnies silently flitting by. Many of the neighbours killed a few hundred to lay away for chicken food. I could at any time have killed 50 an hour. They were in similar abundance from Pembina to Pelly, between the Great Lakes, and in all the wooded mountains of Western Manitoba—throughout the Province indeed, excepting in the pine forests and on the open prairies. Apparently, this condition covered not only Manitoba, but the whole range of the Snowshoe species in Canada. So far as records show, this was the first time the entire range was involved in the flood of population.

Near the Spruce Hill, at the edge of the poplar woods, Carberry, Man., I stood; and looking round, counted the Rabbits within a radius of 30 yards. They numbered 11, and there must have been many that I did not see; so that 20 would be a safe number at which to put them; that is, 20 to the acre. But, dividing it by 2 to allow for the sparser places, it would easily total 5,000 to the square mile.

This would give us over 100,000,000 in Manitoba alone—and on the whole 4,000,000 square miles of choice Rabbit range, such count would yield some 20,000,000,000 of Snowshoe Rabbits.

It was a glorious feast for the naturalist; there is an inexpressible joy in seeing so much wild life. But the farmers, who knew about the ravages of the Rabbits in Australia, began to have the gravest apprehensions. Where would they stop? At present, the Bunny billions were confined to the woods. But another year of increase might—indeed must—make a change. Already the woods were suffering from the ever-hungry hordes; soon they would be driven forth into the crops. Then farewell to the old-time prosperity, goodbye to the golden grain.

The Wipe-out

But the fear was groundless. Before the winter waned, the plague had stalked through the woods and had done its worst, coming and working mysteriously, silently but effectually.

In Manitoba, the country from Whitemouth to Whitesand, 250 miles

long by 150 miles wide, was flecked with the bodies of white-furred Hares. My friend, Miller Christy, who spent 1887 in Manitoba, writes:[14] "On the sides of the line [C. P. R.], as it runs through the wooded country between Portage la Prairie and Carberry, a distance of about 50 miles, the dead bodies of the Rabbits lay literally in hundreds, if not thousands. In some spots, several bodies were to be seen lying near one another; and over considerable distances, a dried, fluffy White-rabbit's body might be seen every few yards, as the train rushed along, lying on the edge of, or close to, the line."

Just so great as were the numbers, was the destruction by the plague. It seemed to have *taken them all.* The summer and fall of 1892, I spent in the same region, and did not see a single Snowshoe. I have heard of one or two areas in Eastern Manitoba where a temporary abundance of Rabbits has been observed since then; but never, in the Northwest, has there been another such Rabbit year as 1886.

In my Arctic Prairies,[15] I have given records and diagrams to illustrate the ebb and flow of animal life; for all species are subject to these changes, although the outstanding example is the Snowshoe Rabbit. Plate XCI (p. 711).

The subject is too vast for treatment in the present volume; moreover, it increases rapidly and becomes more complex—not more simple—as we study it. The reader who wishes to delve into these entraining mysteries is referred to my pages as above for a starting point.

Analysis of the Plague

The next question is one brought forward by Miller Christy in the article referred to: "Why cannot we find in this disease a means of combating the Rabbit-pest in Australia?" Is it not possible that Science may discover a mighty weapon in the virus of the stricken White-hare? The difficulty hitherto has been to bring together disease and pathologist; but an unexpected chance has recently brought about this desirable conjunction.

I had stocked the park about my home with Rabbits—Jacks from Kansas, Snowshoes from New Hampshire, local Cottontails, Prairie-hares from Manitoba. They were in abundance; I could see a dozen Rabbits at least every day. Then, late in the summer of 1903, they began to die, and, in a few weeks, all were gone. The plague had come, and it swept them away. Those found dead appeared to have had their throats cut, but were too far decomposed to be properly examined. All perished but three or four, which

[14] Exterm. of the Rabbit in Australia, Zoologist, Nov., 1892, p. 383.

[15] N. Y., 1911, pp. 95–112.

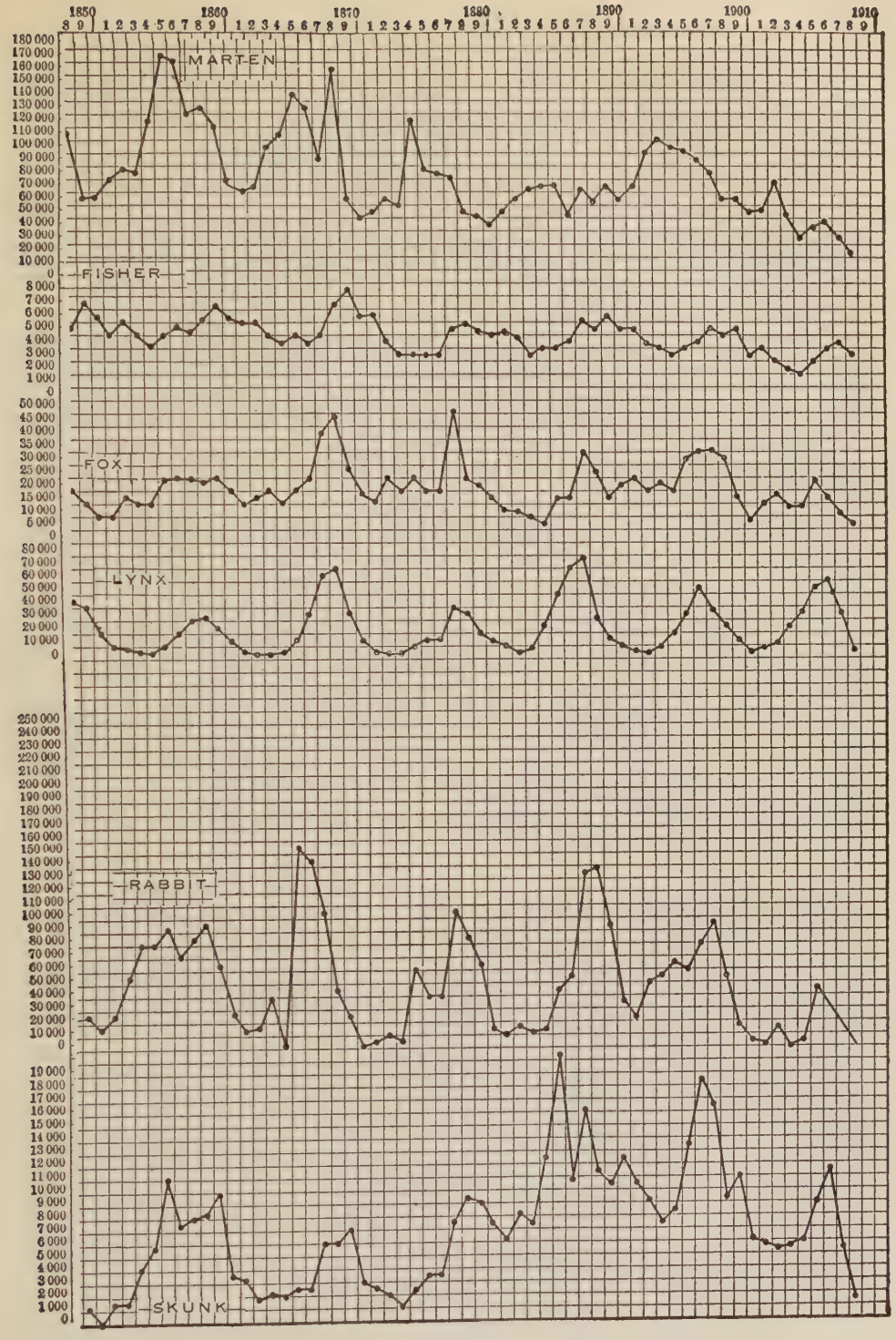

PLATE XCI.—EBB AND FLOW OF RABBITS AND THEIR ENEMIES, AS INDICATED BY THE HUDSON'S BAY CO. FUR RETURNS FOR 60 YEARS

seemed very sickly. In the fall of 1904, I at last secured a freshly dead one with its "throat cut" as before. This was shipped to Dr. Seelye Little, of Rochester, N. Y., who, assisted by Dr. Casey, thus reported:

"Animal very thin; ulcerated sores on skin, especially in region of neck and right side of chest; abdominal organs all right; heart and lungs in good condition. There was a large number of enlarged lymph nodes, many of them having undergone cheesy degeneration. These enlarged lymph nodes were in the region of the neck, the right axillary region, and about the lungs.

"Bacteriological examination: Cultures taken from the lymph nodes (the diseased ones) on agar and on bouillon, all showed a pure culture of the ordinary germ of suppurative processes (the staphylococcus *Pyogenes aureus*).

"Cultures from the lungs were negative. Examination for the tubercle bacillus was negative.

"Diagnosis: The Rabbit died, I should say, from a septicæmia due to infection by the staphylococcus *Pyogenes aureus* (the yellow pus-producing coccus that grows in clusters).

"This infection may easily have started in some accidental or skin wound, or possibly in some parasitic skin disease common to Rabbits, and might easily be transmitted from one to another.

"There was no hemorrhagic condition present in the mucous membranes or elsewhere, though that and very extensive changes in all parts of the body (kidney, liver, spleen, etc.) would doubtless have taken place, had the animal lived longer, because the germs were present in the blood and so were carried everywhere.

Two unfortunate Snowshoe Hares from Maine came in October. Their heads were plentifully beaded with blue ticks; at least a score were hanging about each ear. They died in a short time, and the autopsy showed that they had had still other troubles. Dr. W. Reid Blair, of the New York Zoological Park, examined them and reported:

"Both bodies showed identical lesions, viz.: gastric and intestinal catarrh, with small hemorrhages throughout the digestive canal, caused by round-worms. There were two species of parasites present. The stomach worm, which I recognized as the *Strongylus strigosus*, is a most dangerous parasite, since it lives by sucking the blood of its host, and causes death chiefly by anæmia and emaciation. This parasite is blood-red in colour, about $\frac{5}{8}$ to $\frac{3}{4}$ of an inch in length, and marked by numerous longitudinal lines from which it derives its name (striped strongle).

"The parasites were present in great numbers, many hundreds in each

animal. The species found in the small and large intestines, I am unable to identify; but, since it is not a blood-sucking parasite, it is less important than the stomach-worms. These worms are ¼ of an inch long, and of the thickness of thin twine.

"The oil of areca nut is the best treatment to reach these worms; and the separation of infested animals and the changing of the runs are important matters."

Dr. W. T. Hornaday, who took part in the investigation, adds: "I examined them under the microscope with great interest. They were present in very large numbers, and the eggs which the *Strongylus* seemed about ready to put forth, betokened reproduction by hundreds of thousands. I think the two parasites account for the periodical seven-year plague among the Northern Varying-hares, and also the Rabbits of the West. The life-history of *Strongylus* is not well known; but it may easily develop that the cycle of this creature's destructiveness is seven years long."

Another specimen which died in the park in Jan., 1906, was thus reported on by Dr. W. Reid Blair:

"Death was due to a generalized infection with tape-worm cysts. These cysts are present in enormous numbers in practically all the tissues of the body, the liver, mesentery, diaphragm, spleen, and pectoral muscles being most involved. A multilobular cyst situated over the ribs on the left side was completely encapsulated by the superficial muscles; on removal, it was found to be about the size of a duck's egg, and to weigh 6 ounces. This cyst contained, besides 4 ounces of clear fluid, about 300 heads of the *tænia*, every one of which is fully capable, under favourable circumstances, of developing into a tape-worm.

"Dogs, Wolves, and Foxes are the mature hosts of this particular species of cysticerci (*Cænurus serialis*). Rabbits and Hares harbour the cystic form. Treatment of this disease is out of the question."

Another specimen died from tuberculosis of the liver; others were found, but not soon enough for autopsy. At that time, I also lost Whitetailed Jackrabbits from pneumonia, enteritis, diarrhœa, and inflammation of the bowels. Doubtless, the Snowshoes likewise are subject to these complaints. In fact, they seem to have all the ills of the flesh (except possibly writer's cramp and housemaid's knee); and I feel more and more satisfied that the so-called Rabbit plague is not one disease, but many run riot, through the Rabbits being overcrowded and the whole country rendered unsanitary for their species.

It is worthy of note that a number of Belgian Hares also running wild in the park at Wyndygoul, were *immune from the epidemic*. As this Hare is

simply a race of the Common European Rabbit, the last circumstance should interest Australians who would import our Rabbit disease.

Speed

The Snowshoe's safety is chiefly in its speed. It can clear 8 or 10 feet at a bound, and make 4 bounds to a second; that is at the rate of over 26 miles an hour. It has, further, the two advantages of a light creature—it can get up full speed at once, and dodge with marvellous adroitness. But, above all, its faithful snowshoes are there to turn the dreadful snow-drifts into staunch allies.

Like the Jack-rabbit, the White-hare will sometimes make an observation hop, or high leap, as it runs, to take in the situation; but it does not do it so often nor so well as its prairie cousin. Obviously, the act is of less service in the woods than on the plains.

When pursued by the hounds, the Snowshoe first circles around its home range—maybe a tract less than a hundred yards across. But, failing to get rid of them and their clamour, it makes a wide run next time, covering all the country it knows—perhaps half a mile in extent. Outside of that, it is at sea.

A Strong Swimmer

Few persons know that this dry-land, fluffy thing can swim. It does not love the water, nevertheless, it does not hesitate to take the plunge when it needs must, and swims well for considerable distances. The following instance I recorded at Carberry, Man., in Nov., 1886:

The frost came suddenly and with great severity this year. The weather had been bright and warm all through the autumn, but a strong north wind, with flying snow, set in on the evening of the 21st. In the morning, the lakes were frozen over for the first time. The ice on them was not clear, but largely composed of floating snow, and there was a thin coat of snow on all the land.

As I crossed a small pond near the south side of Chaska Water, I came across a curious and tragic record—a common Snowshoe Rabbit frozen in, near the north margin of the pond. The marks in the opaque ice showed how it had leaped into the water from the south side, apparently to escape a Fox, had plunged through the weeds, and swum across the open part. But the course grew crooked, showing that its strength was going; and at the north end, near the bank, I found its body hard frozen in the new ice.

Its head and back were out of water and dry, its eyes wide open, its legs spread as though striking out. The entire course it left in the ice was

PLATE XCII.—SNOWSHOE-RABBITS PHOTOGRAPHS

To show the autumnal change of colour beginning on the feet, legs, and ears

about 50 feet. Thus was the tragedy written out with fullest details in the ice and snow of the earliest storm.

Dr. Merriam records[16] several cases of Hares afloat, thus: "Rabbits are not commonly supposed to swim, but Mr. William Brewster has kindly written me of a case that fell under his personal observation. He says, 'While at Lake Umbagog, Maine, in the summer of 1873, I saw something which may interest you. I was paddling up Cambridge River one warm July morning, when, upon rounding a bend, my attention was attracted by a slight splashing sound ahead, and looking closely, I discovered a Rabbit (*Lepus americanus*), evidently about to attempt the passage of the stream which at that place was, perhaps, 100 feet wide, and at least 8 or 10 deep. He entered the water deliberately, but without apparent fear or hesitation, and was soon beyond his depth and striking out boldly for the opposite shore. A more ridiculous (albeit successful) attempt at swimming can scarcely be imagined. He literally *hopped* through the water, using only his hind-legs, and kicking with such vigour that the whole forward part of his body was raised above the surface at each stroke. Between the strokes he would sink back until sometimes only the tip of the nose was exposed. I fancy that an immense bull-frog, weighted after the manner of Mark Twain's 'Dan'l Webster,' would cut a somewhat similar figure.

"'This method of progression was naturally fatiguing; and before the animal reached the opposite bank, the strokes became feebler and the intervals between them longer, until I began to fear that the tired creature would be drowned. At length, however, he struck bottom, and, loping across a stretch of bare mud, disappeared in the woods. *Such* an appearance as he presented upon emerging from the water!—the lankness of his form revealed by the clinging and bedraggled fur, the ears drooping, and the whole expression one of dejection and shame.

"'None of the guides or trappers of my acquaintance have ever seen a Rabbit swim; although I have been told of an instance where one was observed to take to the shallow water on the margin of a pond, and run through it for several hundred yards before leaping again into the woods. The purpose of this manœuvre was apparent a moment later when a Sable appeared on the Rabbit's track, and following it to the water's edge, lost it there.

"'On the occasion just described, however, no pursuer appeared, nor do I think that *this* Rabbit entered the water under compulsion, or for the purpose of obliterating the scent of his tracks. On the contrary, the action was undertaken so deliberately, that I believe the animal to have been im-

[16] Mamm. Adir., pp. 309–11.

pelled by some idle whim merely—such as a desire to try fresh pasturage, or perhaps to see what the world was like on the other side of the stream. However this may be, the case is doubtless exceptional, for *Lepus americanus* ordinarily has as great an aversion to the water as any House-cat.'"

To this, Merriam adds: "Nelson Harris, a well-known Adirondack hunter, tells me that while still-hunting in northern Michigan, a few winters ago, he saw a White-rabbit, that had stumbled into camp and was 'cornered,' plunge fearlessly into a swiftly flowing river and swim to the other side."

In the *Journal of Mammalogy*, May, 1921, p. 108, J. Dewey Soper gives an account of a Snowshoe that, of its own free will, swam the icy flood of Hay River, Alta., where it was four or five yards wide, and going nine or ten miles an hour.

Drink and Food

The young Snowshoe will, as I have seen, drink milk in quantities; but, so far as known, the adult never drinks anything.

Its summer food is grass, clover, and a great many herbaceous things that its nose or its instinct enables it to select without danger of being poisoned. Its winter diet is dead grass, buds, and the bark of poplar, willow, dwarf birch trees, and occasionally tamarac. In some localities, it eats a great deal of white cedar and spruce leaves, so that its taste becomes unpleasantly strong of resin, and on that account is judged unfit for human food.

I find a curious note in my journal which may be a food item:

Aug. 28, 1904. While examining Snake Island in Lake Winnipegosis to-day, I was struck by the quantities of Rabbit dung lodged in every cranny of the rocks that characterize the north side of the island. Each sheltered nook was thickly pebbled over with the pellets; in some places, a bushel might have been collected within a radius of ten feet. It was probably left there in winter, as it had the fibrous woody quality of winter dung. It was far above high-water mark, and could not have drifted there. I suppose that the sheltering rocks caused the Rabbits to seek these places. A remarkable feature of the dung piles was a large mixture of crayfish remains. There were hundreds of claws and leg pieces scattered through them. I cannot account for their presence there. Possibly it was accidental.

Sometimes Carnivorous and Cannibal

Of all our rodents, the Hares are least given to flesh-eating. Yet we know the domestic Rabbit will sometimes eat its own young; and I should not be surprised to find the White-hare at some time showing the morbid taste

for meat that it is not supposed to indulge. So I wrote in 1904. The responses to this statement have been many.

Manly Hardy writes: "We caught a Muskrat in a log trap baited with meat quite a way back from the water, and a Rabbit (Hare) in a log trap baited with fish."[17]

Next, Walter McCoy of Washington, D. C., writes me as follows: "In the fall of 1913, I and 2 other persons went down the Athabasca River to about 15 miles below the mouth of the La Biche River. We then went east of the river about 3 miles and built a 'What-not' to live in through the winter. We made 3 Rabbit skin blankets."

His description of the making of those priceless blankets is given in the section on Fur, p. 727. After which, he continues: "Then we simply threw the carcases in piles as so much waste; they made 2 piles about 5 feet across and $2\frac{1}{2}$ or 3 feet high in the middle. They froze hard, and remained so all winter; no doubt, they rotted down the next summer, and made about such piles of skeletons as A. S. Barton describes. The relatives of these Rabbits that we killed, came and gnawed and ate away all the outside of these frozen carcases. They seemed to be especially fond of the paunch and intestines, but they also ate the hams and other fleshy parts as well. In addition to being cannibals, they gnawed at Fox and Weasel and Otter carcases that we threw out. I also saw signs of them gnawing at the dead bodies of such Rabbits as had died of disease and accident in the woods.

"It was not on account of starvation that they were forced to cannibalism, for there were all kinds of brush, and in places, grass, etc."[18]

J. Dewey Soper tells of the Snowshoes demolishing an Ermine trap to get at the meat bait, though it was the hindquarter of one of themselves. He says: "The flesh of one of their own kind is fully as acceptable as any other. Frozen meat they seem to prefer. When one of their number is killed —say by a rifle ball—and left lying, the living of the locality turn to, and make a sordid repast. They start from the wound by licking away the blood, gradually nibbling the flesh and tearing the fur back. I cannot recall ever having seen a perfect body molested, such as one taken from a snare."[19]

Mating and Battling

The mating season is about the first of March. What their marriage customs are, has not yet been ascertained. While many observers consider

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[17] Forest & Stream, May 28, 1910, p. 850.

[18] Personal letter, Dec. 3, 1915, Washington, D. C.

[19] Journ. Mamm., May, 1921, p. 107.

the Hares promiscuous, or polygamous, there is some testimony that tends to clear the species from such charges.

A good father generally means a good husband, and it is strong evidence in favour of their true monogamy when we find the male animal fighting in defence of the young. It points toward pairing, as distinguished from promiscuity, when the male fights in defence of the female. It is, further, a disproof of polygamy when two males live peaceably together in the presence of females during the mating season. All of this we can find in Bachman's description of some White-hares that he kept and bred in captivity. "The old males at this period," he says,[20] in describing their family life, "seemed to be animated with renewed courage; they had previously suffered themselves to be chased and worried by the common English Rabbit, and even retreated from the attacks of the Gray-Rabbit; but they now stood their ground, and engaged in fierce combats with the other prisoners confined with them, and generally came off victorious. They stamped with their feet, used their teeth and claws to a fearful purpose, and in the fight, tore off patches of skin, and mutilated the ears of their former persecutors, till they were left in undisturbed possession of the premises."

No one who has not seen two buck-Rabbits fight, can have the slightest idea of the devilish, deadly ferocity exhibited by these mild-looking creatures. After but little dodging and sparring, they clinch; each seeks to seize the other by throat or jaw or any place to rob him of the use of his own teeth. Then the assailant flings himself on his own back or side, and endeavours, with all the mighty force of his hind feet and claws, to rip open his enemy's belly. The fur flies—the blood flies—the long claws rip into the unprotected front, slash through the skin, and in three or four minutes—unless one gets away—the other is tearing out his victim's bowels—the fight is over!

Nest

I have never seen the nest of the Snowshoe Rabbit. According to some observers, it is usually made in a sheltered place on the ground, under some brushwood or tangle of dead and living herbage, and is admirably concealed. Nevertheless, I cannot find an account of it by anyone who has actually seen and examined it, with the exception of Bachman, whose captive Snowshoes bred in their paddocks. Two of these females produced young which "were deposited in a nest of straw, the inside of which was lined with a considerable quantity of hair plucked from their bodies."[21]

[20] Q. N. A., I, pp. 98–99.

[21] As above, p. 98.

Tracks of the Snowshoe-rabbit.

Feet of Hares, half life-size. The three at left illustrate the Snowshoes of the *Lepus americanus;* the two at the right the feet of Kansas Jackrabbit (*Lepus melanotis*), which weighs twice as much

PLATE XCIII.—DETAILS OF SNOWSHOE RABBIT

Percy H. Selwyn, of Ottawa, tells me that in Brandon Hills, Man., June, 1887, he found some young Snowshoes nesting in a hollow poplar stump.

It is well to remember that the Jackrabbits, its near relatives, make no nest whatever. Probably, therefore, the same will prove true of the Snowshoe in its wild state.

Bearing Time

The period of gestation is probably 30 days, as is the case with the European Hare, but I have no direct evidence. On April 10, 1882, I shot a female White-hare at Carberry (that is, where Carberry came afterward), which contained 2 very small embryonic young. They were probably of two weeks' development, and due to be born late in April. Litters are produced all through May, and even as late as the first week of June.

Dice says: "On July 25, 1911, half-grown young were numerous at Tanana. Aug. 2d, a female containing 6 large embryos was taken at Fairbanks. At the head of the North Fork of the Kuskokwim, a female containing a number of formless embryos was taken May 3, 1912; and one with 3 embryos, each about 110 mm. [$4\frac{5}{16}$ in.] in length, on May 15th. May 29th, a juvenile about one-third grown was seen. A female with 6 large embryos was taken June 24th on the Kuskokwim-Minchumina portage."[22]

Young

The young are usually 2, sometimes 3, in number. Cases are on record of 4 and 6. C. W. Nash tells me that he once found 7 embryos in a female of this species. R. MacFarlane contributes an item of exceptional interest. "A litter," he says, "usually consists of 3 or 4; but when on the periodic increase, females are known to have as many as 6, 8, and even 10 at a time, and then gradually return to 3 or 4."[23]

According to all testimony, the young are born with eyes open, and are covered with very fine, close hair.

The males of those that were bred in captivity by Bachman[24] "did not evince the vicious propensity to destroy their young, which is observed in the domesticated English Rabbit; on the contrary, they would frequently sit beside their little family, when they were but a day or two old, seemingly to enjoy their playfulness and to watch their progress to maturity."

These young ones "left their nest in ten or twelve days and from that

[22] Journ. Mamm., Feb., 1921, p. 28.

[23] Mamm. N. W. T., 1905, p. 740.

[24] Q. N. A., I, p. 99.

time seemed to provide for themselves and to derive little sustenance or protection from their mothers."[25]

The following notes by Mrs. Mildred B. Caldwell, furnish new light on the Snowshoes' babyhood.

"Friday, June 5, 1925. Five baby Snowshoe Rabbits were found under a pile of boxes at Camp Miramichi, Merrill, N. Y. They measured about 5 inches in length, and weighed perhaps 3 or 4 ounces; were still nursing, and quite wobbly on their feet. Three out of the 5 had a white line down their foreheads, of varying lengths, from ½ to 1 inch. On Saturday, one had disappeared, and we barricaded the little den against Foxes, as a track had been discovered near by.

"We were anxious to tame them, so I gave them forced feedings of milk, water, and a touch of sugar, from a bottle with a bit of linen tied over the mouth. They learned to draw out the milk, but with little enthusiasm; so we judged the mother must be caring for them, although we had never seen a trace of her at any time of the day or night. On the third day, the largest and strongest one disappeared, and we feared for its safety. But late that night it was snuggling in with the others in the smallest possible space; apparently he had been taken out for a day's jaunt.

"That night, we decided to find out definitely just when the mother Rabbit came, if at all; and we banked the entrance of the den with damp sand. The next morning told the story of the mother and her behaviour with the babies. Large Rabbit tracks were found crossing in front of the entrance, not nearer than 10 inches; in the entrance itself a myriad of wee tracks as the babies had come (apparently by signal) to their mother, and had done their nursing outside.

They were such funny, sweet-smelling things, with the fragrance of balsam clinging to them. Their little faces were so broad and whiskery, with just little bits of ears, giving them a strange human look."[26] (Plate XCIV, p. 726.)

My impression is that when the young are about two weeks old, they leave the home place and never return to it. Then and there the family is scattered. They are now independent of the mother's care, and are seldom seen near her. I never expected to hear of a mother Hare followed by her brood, so was much interested in an exceptional case observed by D. R. Hanford, of Duluth, Minn. His record contains more than one surprise:

"Two years ago this June," he says, "while trout-fishing on French

[25] Q. N. A., I, p. 98.

[26] Personal letter, July 7, 1925.

River, a stream some twelve miles from here, I saw a mother Hare, coming down the trail, followed by 4 young ones, half or two-thirds grown. Upon killing the mother, we found 2 young ones, fully developed, and about ready for birth."[27]

On June 21, 1883, I was seeking for birds' nests in the Carberry Spruce forest (Manitoba). A white-throated sparrow was chirping plaintively near, and I was peering into every likely place for the nest; when under a brush pile, I saw a young Hare crouching as still as a moss bump. I cautiously reached down through the branches, and caught it, whereupon it squealed vigorously. An old Hare, doubtless the mother, came running through the woods. She rushed about in distress, keeping at a distance of fifteen or twenty yards, but seemed half-disposed to attack me. The little one ceased squealing when put in my pocket, and then the mother disappeared.

The place where it had been sitting was a mass of twigs, but I think not a nest; no sign of fur or lining was to be seen there, nor were any brothers visible; besides, it was now a quarter grown, evidently old enough to run with its mother. Judging its development by that of the domestic Rabbit, it was about three weeks old, and therefore born about June 1.

On Sept. 7, 1902, in the Bitter-roots of Idaho, I caught another half-grown Rabbit in the same way, but saw no parent.

The mother Snowshoe has never been recorded actually fighting for her young, but most of the family are known to do so; and as a hint of what to expect on fuller observation, I add some paragraphs by James Edmund Harting on the common Wild-rabbit (*Oryctolagus cuniculus*) of England:

"In Oct., 1891, a game-keeper in the service of Mr. Deacon of Southborough, Tunbridge Wells, on going through a wood, saw a Stoat which had caught a young Rabbit, playing with it as a Cat does with a Mouse, letting it go and then catching it again. Before the keeper could interfere, he saw a full-grown Rabbit, probably the doe, rush out of some underwood close by, knock over the Stoat, and carry off the young one in its mouth. The Stoat, on recovering itself, followed through the underwood, but presently reappeared in retreat pursued by a couple of Rabbits."[28]

As further evidence, I may say that I have been attacked several times, and bitten as well as scratched by an old doe Belgian hare, whose young I was trying to pull out of their underground nest.

The young of the Snowshoe are usually full grown by autumn, but do not breed till the following spring.

[27] Letter of April 24, 1907.

[28] The Rabbit, 1898, p. 20.

They are mature at a year old, and are believed to live for eight or nine years, unless, as more often happens, the Remorseless One removes them as soon as their powers begin to wane.

Wabasso's Foes

A full list of the Snowshoe's enemies would give first place to the plagues already described; next would be a catalogue of all the predaceous birds, beasts, fish, and reptiles in the country. Anything can kill a Hare that can catch it. Its only safety is in its speed among the tangled copses, a speed which, thanks to its snowshoes, is not diminished in the season of stress, but relatively increased. In the open, this is of high order—not enough, perhaps, to save it from a Fox, but sufficient, as I have several times seen, to put Wabasso beyond reach of an ordinary collie Dog. In the undergrowth, however, it is absolutely safe from the open attack of nearly all.

The Hare can dart at speed between saplings that are but three inches apart; it can double around a bush or under a fallen tree, in a way that mocks at the Fox, Lynx, hawk, or owl. But it often falls into their power, when they steal on it sleeping, or when two of its foes unite and so form the "drive and ambush."

These combinations are not pre-arranged, A Fox, seeing another Fox or a Lynx creep into the Hare cover, may lie in wait on some runway without the knowledge of the hunter before him. Even a hawk or owl, I am told, will circle around a Hare home, while a Fox is ransacking its depths, knowing that in the general stampede, there is an excellent chance of good things coming his way.

The Hare has one four-footed enemy that, though much slower than itself, is yet a terror—among the worst of all; and that is the Brown or Ermine Weasel.

I have many times seen the trail of the pair in the snow, showing where the Weasel, with indefatigability that more than made up for its lesser speed, was bounding along the track of some Hare. I have many times heard of the finish of that hunt, but have never seen the actual death.

During the December of 1886, I saw a chase that had a very unexpected end. I was out with a friend hunting in the sandhills north-east of Carberry. The Snowshoe Rabbits were very abundant in the thicker woods, and there were some in an open grove where we halted to feed our Horses. While there, I saw one running about at full speed; and after it what at first I took for a smaller Rabbit in hot pursuit. As it circled in full flight around our sleigh a

number of times, I learned the cause of its haste. The smaller one behind was not a Rabbit at all, but a White Weasel, plunging along with tremendous energy through the snow, and evidently running this Rabbit down. The Weasel was winning. He was within a few yards of his victim, when at last the Rabbit, in desperation, took refuge near my feet, under the sleigh; and the Weasel, deciding to be discreet, ran off before I could lay my hands on a gun. There is not the least doubt that the Rabbit feared me as an enemy, for shortly before, it had been running from me. But it did as many others have done in dire extremity; and in this case, at least, proved it the part of wisdom; for a little later, it went its way in peace.

One of the most unlooked-for destroyers of the Snowshoe is the Franklin Ground-squirrel. In the *Journal of Mammalogy* (Aug., 1922, p. 187) Arthur M. Johnson tells of a young Snowshoe killed by one of these unexpected foes. This incident is more fully set forth in the Life of the latter animal, p. 256.

Strange Blunders

The white and horned owls are well known as deadly enemies of the White-rabbit. Their annual toll of his numbers must be terrific. He is so defenseless, once they find him in the open, that the owls have no hesitation in pouncing on poor Wabasso. They are so precipitate, indeed, that sometimes they fall into error, as these instances show.

George H. Measham, of Winnipeg, writes me: "I once owned a tabby tom-Cat, a friendly old thief that would follow me like a Dog, when the whim took him. I had occasion to take a walk of about a quarter of a mile from the house one misty evening, just at dusk; and old Tom, feeling like taking a constitutional, came along. There was a little snow, and I suppose Grimalkin's feet were getting cold; so, on turning homewards, he ran on ahead a hundred yards or so. Then, sudden and mysterious in the half gloom, appeared a magnificent snowy owl. Twice he swooped at the astonished Cat and twice reconsidered—that Rabbit was evidently not quite orthodox. A third time the white terror swooped at the quarry, and this time seized old Tom in his iron claws. But—he had caught a Tartar. Tom may have lost two or three of his nine lives in that desperate battle in the air, but, at any rate, he saved the remaining six. Falling on his feet, he made for home at a mile a minute. He was a very quiet Cat for a few days after this adventure. I often wonder what the owl thought about it all."

A still more preposterous blunder is thus related by Manly Hardy: "Some time in the night, while sound asleep, I was awakened by having my head suddenly jerked up; and, on fully awakening, I could feel several places

on each side of my head smarting. It was easy to tell the cause. My head was not covered by the blanket, and my hat had fallen off. An owl, mistaking my head for a Rabbit or some other animal, had seized me, and on my speaking, had let go. This is not an uncommon thing, as I have known of several other cases; and Napoleon A. Comeau, in his 'Life and Sport on the North Shore,' p. 422, speaks of knowing several similar instances. In all the cases I have known—some six in all—it was evidently done by mistake."[29]

Parasites

Deer have bots, warbles, and flukes; Foxes have flies and lice, grouse have ticks and tape-worms. But the unfortunate Hare is harassed by each and all these little pests, as well as by every bird, beast, fish, and reptile of prey that inhabits his country!

No matter what time of summer or fall you examine a Snowshoe Rabbit, you will find firmly attached somewhere about him at least one or two of the blood-sucking wood-ticks (*Ixodes*). I found them on two males taken June 25th; each was decorated with about a dozen. On specimens which I got at Ingolf in Sept., 1904, I found several hundred ticks, varying in size from pin-heads to peas. They were in the ears of the Rabbits; the lower part of the ear in each was clogged with a mass of ticks; none, however, had ventured into the wax-protected inner vestibule. As soon as their host was dead and cold, these ticks loosed their hold, and scrambled in all directions, seeking elsewhere for a renewal of comfort. On October 15th, I received two Snowshoes from Maine; and, on the 22d, two more; all had the ears beaded with scores of blue-ticks.

Plentiful as they are now, I am inclined to think the ticks have been worse, as attested by the following paragraph from Henry's "Journal" on the Red River (p. 180; see Beaver References):

"Ever since April 25 [1801], we have been plagued with wood-ticks [a species of *Ixodes* E. Coues]; and now that we are daily in the woods and grass, our clothes swarm with those troublesome and dangerous insects, which often get into the ear and cause inflammation. When they have time to get firm hold, they cannot be removed without pulling the body from the head, which remains in the skin, and causes an itching which may last for several months. The bellies of our Horses and Dogs are covered with them; they adhere to the flesh until they have sucked themselves full of blood, and are swelled nearly to the size of a musket ball, when they fall off of themselves. Their natural size is about that of a grain of barley, and in shape, they are

[29] A Fall Fur Hunt in Maine, Forest & Stream, May 14, 1910, p. 769.

perfectly flat, with a tough hard skin of a chestnut colour. They continue to the end of July, when they suddenly disappear."

His Damage

There is not an animal in these Lives that has not, by someone, been declared a nuisance and fit subject for a war of extermination. Either they destroy man's crops, or annoy his Dogs, or harbour disease, or injure his earthworks, or, in some other way, offend him.

What possible harm can be done by the Snowshoe? He is innocent of violence; he is good to hunt and good to eat; he avoids all settlements; he is the embodiment of timidity and harmlessness. So we thought; but now comes the Minnesota forester, and complains:

"The Snowshoe Rabbit is the one principal factor in the loss of a considerable number of planted trees in the forest plantations of northern Minnesota," states Director Raphael Zon, of the Lake States Forest Experiment Station at St. Paul. "The abundance of the Rabbits this year and the damage they are doing, are evident to the most casual observer who visits the cut-over areas of the region, where both State and Federal authorities are endeavouring to make denuded forest land again productive through extensive planting of young pine seedlings." The Editor of *Forest & Stream* comments thus:

"In giving examples of recent damage to support this statement, Director Zon declares that as much as 79 per cent. of the trees in one plantation were eaten off by the Rabbits, 43 per cent. fatally."[30]

A Giver of Meat

The knowledge that the White-hare is so subject to disease may keep many from using the flesh for food; thus exemplifying the danger of a little knowledge. These persons should remember, first, that there is no record of anyone getting disease from Rabbits they have eaten. Second, every kind of human food, whether animal or vegetable, is more or less infested by microbes. If that thought is to weigh, we must never again eat a bite of *anything*. There is no way of saying beforehand which foods are safe and which are dangerous; but we must trust to the general principle that proper cooking will put all these micro-organisms beyond the possibility of doing harm.

The Hare Indians of the Mackenzie were so called because they counted on this Hare as their mainstay in winter. Yet all who travel the Far North

[30] Forest & Stream, Dec., 1924, p. 768.

PLATE XCIV.—SNOWSHOE-RABBITS, YOUNG, AND ENEMY

No. 1. Snowshoe Rabbits, winter, photo. by E. T. Seton
No. 2. Young Snowshoes, by H. & E. Pittman, of Wauchope, Sask.
No. 3. Baby Snowshoes, by Mrs. M. Bedard Caldwell
No. 4. Horned Owl and dead Rabbit, photo. supplied by Dr. W. A. Bruette, of *Forest & Stream*, Dec. 30, 1924

country, agree that Rabbit meat is poor, innutritious stuff; it is a mere stop-gap in dearth of other foods. One cannot work hard or long on Rabbit meat; and the Indians, when they have none other, say they are "starving on Rabbit."

His Fur

Next after the flesh, the skin of Wabasso is of service to man. The hide is too weak and the fur too brittle for its commercial use as a peltry; but the Indians cut it into long strips, and plait or weave these into blankets that are marvellously warm; and that have this advantage over other fur robes—they give ventilation, and so do not sweat the wearer, or become damp during active service. They are very light as well as warm, and in great demand by prospectors and travellers in the Far North. Many a miner, of the few that won on that long, desperate Klondike trail, can truly give thanks, for salvation and golden success to the Snowshoe Hare, from which was pillaged the blanket that kept him alive to win.

Walter McCoy, of Washington, D. C., when wintering on the Athabaska with two trapper friends in 1913, made 3 Rabbitskin robes. He says: "It took about 130 Rabbitskins to make each blanket. We . . . cut . . . the skins into strips about $\frac{3}{4}$ to one inch wide, and 5 to 8 feet long, depending on the thickness of the hide and the size of the Rabbit."[31]

As to the making of these robes, E. A. Preble says:

"The skins are cut into strips, which are twisted, and woven on a frame into a robe of the desired size. The mesh is very coarse, and the fingers may be thrust through the finished robe at any point. The loose, soft fur, however, resists the action of the wind, and on account of their lightness and warmth, these robes are considered second only to those made of Caribou skins, and are preferred by some. To obviate the unpleasant consequences of the shedding of the fur, they are usually inclosed in a cotton case. Capotes, shirts, and mittens made in the same way were formerly in common use, and are still made by some of the remote tribes."[32]

Another interesting use has been found for his fur. The whole kingdom of Wabasso is inhabited by chickadees of one or other species. There must be full a million pairs of these blithe winter sprites in the great North Wilds of pine and snow; and we are assured that each and every one of these was cradled in a nest that was lined and warm with Rabbit fur. They always use

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[31] Personal letter, Dec. 3, 1915.

[32] Athabaska-Mackenzie, N. A. F., 27, 1908, p. 201.

it when they can get it, and we are safe to say that they can always get it.

Strange Incidents

During the great rabbit year on the Mackenzie (1903–04), Chief Trader C. Harding, of Fort Resolution, tells me that twice it happened that two Rabbits were taken at once in the same snare; they were coming from opposite directions, and had the luck to arrive at the same time, put their heads in the same noose, and suffer the same fate.

W. G. Tweddell, of Woonona, Man., calls my attention to the fact that sometimes White-hares are caught bearing dermoid cysts in their flesh. These are growths covered with skin, more or less hairy, and sometimes even provided with teeth. The Indians treasure these as great medicine, and call them *Pee'-to-wab-oos-ongs'*—that is, "the little Rabbit within." To pass one of these through a Rabbit snare is, they believe, to guarantee its immediate success. Such cysts are well known, and have already been mentioned in the Moose Life (Vol. III, p. 158).

This same hunter relates another strange case: In Feb., 1883, while hunting with the Chief Metwayash at Rabbit Point Lake, Man., he caught sight of a Snowshoe Rabbit twenty feet up a sloping tree. On examination, it was found dead and frozen stiff, one leg caught in a crotch. He is satisfied that it was not put there by any man, but that the creature ran up, possibly scared by a Fox; then, slipping, was caught and held till dead. This is the first time that he ever heard of a Rabbit climbing a tree.

A singular monument was found on Turtle Mountain, in 1896, by A. S. Barton. While seeking an old Indian camp on a wooded hill, he found several piles of Rabbit skeletons—skulls and other bones complete. The piles were three or four feet across and a foot high. I doubt not these Rabbits were collected by the Indians in time of plenty; they had secured hundreds of them, and left them frozen. In the spring, when the Indians moved away, these were left to rot.

An illustration of the fascinating power of a lantern I find in my journal for Sept. 16, 1904. I was then at Ingolf, Ont.; and during a stay of twenty-four hours, I and two companions saw over 20 live Rabbits in the woods, and found 6 dead on the railway track. These, the station agent said, had been killed by the trains. At night, they get on the tracks, and are so bewildered by the headlight, that they run before the engine until overtaken. Apparently, it does not occur to them to plunge out of the brightly lighted dangerous space into darkness and safety at one side. The figures above show that a considerable proportion may be thus destroyed.

His Personal Habits

"As much wit as a Rabbit" is an old expression of contempt among Red-folk as well as White. The rodents are not high in the order of intelligence, and the White-hare is low among rodents. His keen senses, his wonderful speed, the willow thickets, and finally, his snowshoes, are the reasons he is left alive to-day among countless enemies; for he is not equipped in any degree to battle in self-defence. His speed and fecundity are indeed his holds on existence.

The Snowshoe Rabbit dresses his coat much after the manner of the Cat, and is, in some respect, a model of cleanliness. But he does not hesitate to void his dung in the nest. This violation of the sanctity of the home is a mortal sin, one for which nature makes him pay dear in the end. This may be the very breach by which the dreaded epidemics are enabled to enter in, and work such havoc on the race.

Plate XCIII (p. 719) sets forth the tracks very fully, except that it does not show the 8- and 10-foot bounds that the Hare can make, or suggest the wonderful lightness of his tread on the lightest of snow.

As a rule, the Varying-hare crouches quietly in his form all day; toward sunset, he often moves to some high place where he can sit in the light of the red orb, as though to enjoy the scene. Soon afterwards, he stretches his legs, and hops away to seek his favourite feeding-grounds, remaining more or less active until dawn. He may run about the woods in early evening, but he is very careful, when making a foray on the farmers' pea-fields or gardens, to do it only under cover of darkness.

Winter Life

The life of the White-hare is in the same places, and continues much the same, in winter as in summer. The principal changes are those of coat and of diet.

So far, I have not seen any sign of migration in the species. The individuals that I had in my park, kept the same part of the woods all the year round; and the three or four forms that were their homes when the snow was on the ground, were still their homes in the height of the warmest weather.

I suspect, however, that it has a habit of occasional torpidity. It is well known that the English Hare and the Common Cottontail will lie up, under stress of bad weather, letting the snow drift over them. There they continue several days without eating, and in a semi-torpid state, until aroused by some outside change for the better. I never saw a White-hare doing this;

but from the fact that no tracks are seen for a day or two after a very cold spell, I can readily believe that they share the family habit. In the case of the White-hare on the knoll, referred to in the section on Home Range, his tracks were not seen for two or three days after each heavy snowstorm; and in the spring, we found a lair in a rocky crevice where, no doubt, he whiled away the worst of the weather.

Writing of his hunt after Snowshoes in Pennsylvania, just after the first snow, C. M. Oves says: "It was a bright, sunshiny day, warm and lazy, and every one of the four Snowshoes was under a log, and permitted a close approach—a thing impossible under any other circumstances. Another thing, it has snowed for three days, yet there wasn't a single track leading to or from the log where I had scared the young one. The natives claimed that since it was his first snow, he wouldn't have ventured out till he was almost starved."[33]

Sociable Instincts

The Snowshoe is sociable only in slight degree. These Hares come together when their numbers are such that they cannot help it; and, on the whole, are not benefited by such close association. The only advantages they reap are that the pathways are kept well worn and open; and they notify each other of danger by stamping, by running, or, in extreme cases, by squealing. As a matter of fact, these Hares intercommunicate little but trouble and disease.

Among many human races, there exists a prejudice against moonlight. It is interesting to note that the animals do not share this feeling; indeed, there are many species that make the moonlight nights their chosen time for sallying forth.

J. Dewey Soper describes a moonlight gathering of Snowshoes around his cabin on Hay River, Alta., in 1913. He says: "One sparkling moonlight night, they visited the clearing in unusual numbers. . . . All seemed imbued with a spirit of festive joviality, doubling about with playful pranks and short sallies of wild abandon, but ever and anon returning to the sumptuous feast.

"Observed from the cabin window, this pantomime went constantly on; the revellers seemed never to tire. Some fed, some frolicked as in games of tag; but a rigid alertness never for a moment ceased. Always one or more of the company sat erect on its haunches, alert, ears forward, nose aquiver, sifting the implications of the night. One ominous sound or sign was enough to scatter this merry assemblage to dark and distant shadows. When one

[33] Field & Stream, March, 1917, p. 396.

PLATE XCV.—SNOWSHOE RABBIT—POSES FROM LIFE

watcher went down, another was already acting as sentinel. Still new arrivals came hastening along the ramifying trails. It seemed probable that the entire Rabbit population within a wide radius were conscious of this regal occasion. At one time, we counted 25 in easy view; double that number were possibly present; some hidden behind the piles of boughs, or in the shadowy outskirts of the moonlight."[34]

On June 25, 1884, near Minnedosa, Man., I saw two Hares chasing each other among the willow thickets. On being "collected," both proved to be males. The energy with which they were engaged, however, was suggestive of battle rather than play.

The Cry of the Hare

I have often heard the White-hare give a loud squeal when in extreme fear, but I think *not* when in great pain. This squealing is uttered also by the Cottontail, the English Rabbit, and the English Hare. The female of the last-named is said to have a soft plaintive call for the young. The Jackrabbit of Kansas, I know, makes a snarling sound, when fighting with its own kind. Probably these cries are also uttered by the Snowshoes.

Since the foregoing was written (1904), young naturalists have increased in the land, and additional observations are opening up new possibilities. G. G. Goodwin, discoursing on the mammals of Gaspé, says: "About 12 o'clock one night, we were awakened by some animal making a peculiar cry in the tent. Getting out a flash-light, we saw a large Hare sitting up in the middle of the floor; after a few minutes' inspection, it leisurely retreated through the entrance."[35]

A still more suggestive paragraph is offered by John Fottler of Boston, Mass. This also was in Gaspé. He says: "Although it was early October, there was about a foot of snow, and the weather very cold.

"The second night was bright moonlight; not a breath of air stirring, and the silence was so intense that it seemed weird and oppressive, bringing a feeling of terrible loneliness.

"Some time during the night, our whole camp was suddenly aroused by cries that apparently came from quite a distance; such wails of agony I had never before heard, and I hope never to hear again. No child lost in that dense wilderness could have so pathetically expressed its misery. Those cries have haunted me ever since.

"We were horror-stricken to hear that rapidly repeated wail of some poor creature calling to God in its dire distress.

[34] Journ. Mamm., May, 1921, p. 105.

[35] As above, Nov., 1924, p. 257.

"Our men turned out to investigate. I asked to have someone go at once and release the poor thing, whatever it might be; and two of the men started out. On their return, they reported that a Hare had been caught by one of its fore feet in a snare that had been set the day before; and that this was a full quarter of a mile from the camp."[36]

Drumming Signals

Every child who keeps Rabbits knows that they express anger and some other emotions by thumping with the hind feet. Most of us have seen a tame Hare that would drum on a tambourine at command. But not all of us have realized that these performances are mere hints of the thumping signal-code, that is more or less used by all wild Rabbits.

While camped in the Bitterroot Mountains of Idaho, Sept. 7, 1902, I saw something that looked like a social gathering among the Snowshoes. It was called together by the drumming of a captive. I had secured a half-grown one; and at night, put it under a thin, hard leatheroid box. It soon made the forest ring with a loud tattoo beaten on the box with its forefeet. Again it sounded, *tr-r-r-r-r-r*.

Shortly afterwards, a full-grown Snowshoe Rabbit darted across the open camp space, and into the dark forest again. Another and another appeared, and we heard the alarm *thump*, *thump*, *thump*, in the woods around, and a responsive *tr-r-r-r-r* from the box.

Armed with an acetylene lantern and a camera, my companion, W. E. Bemis, and myself went forth to investigate. As we set the lantern on the ground, a Rabbit rushed into the light, gazed at it, and disappeared. Another came, gazed, gave an alarm thump or two, and vanished. Then two came, then others, then more—a dozen Snowshoe Rabbits, at length, were gazing into that marvellous light. One gave the alarm, and all dashed off. But they came back, and yet closer; and began to caper about in the bright place, and chase each other in play, leaping past the lantern which I held on the ground, and over the camera which my friend was holding.

At length, one of them jumped on the camera between Bemis's hands, and was caught. It shrieked with terror. In a twinkling, every Rabbit had disappeared; and, though we were two weeks longer in that same camp, we did not see another of this species.

[36] Forest & Stream, Feb., 1921, p. 78.

References

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LIFE XCVI—BLACKTAILED JACK

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Jackrabbit, Californian Jackrabbit, Blacktailed Jackrabbit, Gray-sided Jackrabbit, Narrow-gauge Mule, Jackass-hare, Texas Jack, Texan Hare

Lepus californicus Gray

(L. *Lepus*, a Hare; L. *californicus*, of California)

Lepus californica GRAY, 1837, Charlesworth's Mag. Nat. Hist., I, p. 586.

TYPE LOCALITY—"St. Antoine" (Monterey Co.?), Calif.

MEXICAN, *Liebre.*

In addition to the generic characters, the Blacktailed Jack has:

Size. Total length, about 24 in. (609 mm.); tail, $3\frac{3}{4}$ in. (95 mm.); hind foot, $5\frac{1}{2}$ in. (130 mm.); ear from notch in dried skin, $4\frac{7}{8}$ in. (124 mm.).

Weight of fall specimens taken at Clayton, N. M.: ♂s, 5 lbs. 7 oz.; 5 lbs. 3 oz.; 5 lbs. 12 oz.; 6 lbs. 5 oz.; 6 lbs. ♀s, 5 lbs. 8 oz.; 5 lbs. 12 oz. ♂s taken at Victorville, Calif., March 19, 1922, weighed 5 lbs., and 5 lbs. 12 oz.

Colour. At first sight, this is a very brown Rabbit, with buffy underparts.

A typical male taken at Glenellen, Calif., Jan. 12, 1882, is as follows: All above, wood brown or dark buff, thickly peppered with black hair tips; also dark-flecked by blackish middle part of each hair showing through. All below, clear, deep, warm buff. A small white blaze on forehead (sometimes wanting); a white ring around each eye. Chin, white; cheeks, legs, and flanks, tinged with sienna; breast and belly, buff. Leather apron or breast plate, warm, grayish brown or buff. Tail and rump, browner, but on top of tail is a jet black band which joins the dark gray of the back.

The ears are remarkable. On top, as they lie down, they are like the head—soft buffy, finely peppered with black; behind, pure white, with a large black spot an inch long near the tip. On the outer edge, is a narrow band of white velvet, reaching $\frac{3}{4}$ of the way to the tip; on the last $\frac{1}{4}$ it is replaced by a black edging. On the opposite or inner edge, is a whitish fringe of coarse bristles nearly to the tip. Under each ear, on the neck, is a white patch.

These are, indeed, some of the Jackrabbit's tints; but they are varied with a hundred different plays and pretty shades, deepening to sienna and black, or paling to gray and white.

The *nursery fringe* is a very well marked feature. It covers the belly, and is of very long, soft and fluffy hair and down mixed. It is dull whitish, with a brown stain at each knee. It is admirably adapted to cover the young as the mother poises lightly above them.

The male also has this fringe, though it is less developed.

Races

The following races are recognized:

californicus Gray, the typical form, and darkest of all. T. l., St. Antoine (Monterey Co.?), Calif.

wallawalla Merriam, most like *deserticola*, but upper parts darker, more pinkish iron gray. T. l., Touchet, Walla Walla Co., Wash.

richardsonii Bachman, smaller than *californicus;* head and upper parts of body, light yellowish or grayish buff. T. l., probably near Jolon, Monterey Co., Calif.

bennettii Gray, smaller than true *californicus;* with lighter skull; colour of upper parts paler, more grayish, buffy brown. T. l., San Diego, Calif.

deserticola Mearns, slightly smaller than *californicus;* colours, very pale. T. l., Colorado Desert, Imperial Co., Calif.

eremicus Allen, size of *texianus;* in colour, much paler than *californicus;* darker and warmer than *texianus*. T. l., Fairbank, Cochise Co., Ariz.

texianus Waterhouse, a large, light-coloured form, paler than *eremicus;* little, if any, buff on sides. T. l., probably western Texas.

melanotis Mearns, a richly coloured, buffy race; yet much paler and grayer than *californicus;* underparts, white. T. l., Independence, Montgomery Co., Kan.

merriami Mearns, a large, dark brownish race, with a black nape. T. l., Fort Clark, Kinney Co., Tex.

asellus Miller, like *merriami*, but much larger, and with grayer ears. T. l., San Luis Potosi, Mex.

festinus Nelson, above, dull brownish, like *eremicus*, but darker; ears, longest, except *martirensis;* underparts, white. T. l., Irolo, Hidalgo, Mex.

martirensis Stowell, size of *californicus*, with much larger ears; upper parts, iron gray; underparts, deep pinkish buff. T. l., San Pedro Martir Mts., Lower Calif.

magdalenae Nelson, upper parts, buffy brown like *xanti*, but lightly washed with black; in general, paler; ears shorter, and whiter behind. T. l., Magdalena Id., Lower Calif.

xanti Thomas, back and sides, pinkish buffy brown; somewhat like *bennettii;* head and ears, grayer than in *martirensis;* underparts buff. T. l., Santa Anita, Lower Calif.

insularis Bryant, above, glossy black, grizzled on sides; underparts, cinnamon; size of *californicus*, with shorter ears. T. l., Espiritu Santo Id., Gulf of Calif.

This last, *insularis* or the Black Jackrabbit, deserves more than mere mention. It inhabits the small island of Espiritu Santo, which is about 15 miles long, and but 4 miles from the mainland where dwells the pale desert-coloured *xanti*, which is its nearest relative. And yet, *insularis* is a black Jackrabbit—everywhere dark, and on its upper parts, glossy black. This extraordinary product of environment and isolation is fully described in Nelson's monograph, pp. 36, 37, 156, 157, and 158.

Range and Haunts

Map XIX (p. 739) shows that the range of the Black-tailed Jackrabbit and its near kin is from about longitude 95° W. to the Pacific coast, and from about latitude 43° to the Tropics; overlapped in the north by the Prairie-hare, and in the south, by the Antelope-jack.

Everywhere, fixedly, and all the time, the Jackrabbit is a creature of the open plains. Where there are plains in its region, there are Jackrabbits; and if there be a stretch of forest surrounded by Jackrabbit country, we may rest assured that the Jacks will not enter the shade of the timber.

In northern California and Oregon, the tint that stands for "Jackrabbit" seems to reach into the big-timbered country; but, as a matter of fact, in that region, the Jack is found only in such parts as are open and clear. The species eschews the big woods, as it does open water, swamps or rugged mountains. A thing of speed, it must live where its speed can always be put forth in an open, straight-away race.

And yet nowhere on bare, flat earth or sand is it found; but ever on the plains, with scattering sage, mesquite, greasewood or cactus. It is, above all things, the child of the sage-bush—cloaked with a sage-gray cloak, helpless

MAP XIX.—RANGE OF THE SNOWSHOE RABBIT AND OF THE BLACKTAILED JACK

By E. T. Seton, with assistance of the Biological Survey, 1927

against air attack out on the bare plains, abounding exactly where the mothering sage abounds.

Home Range

How big is the home range of the individual? On this, I secured some evidence years ago, by following patiently for many hours through the snow, the track of a fine, big Kansas Jack that was known in the vicinity of Newton, Kan. A square mile roughly represents the area out of which he would not willingly go. This conclusion is sustained by many other observations, as well as by analogy.

The Mating of Lothario

No conclusive evidence is at hand on the mating of the Jackrabbit. What little is recorded, suggests that the Jack does not pair; and since promiscuity and polyandry are rare, the established way of the big Jack-hares is probably polygamy. Nevertheless, it is tandem rather than four-in-hand-polygamy, as far as known. My notes made in California have some bearing. They are as follows:

Victorville, March 24, 1922. The Jackrabbits are in full rut just now. The testes of one measured were $2\frac{1}{2}$ inches long, by $\frac{7}{8}$ wide each, and yet were easily pushed back into the abdomen.

This morning, A. M. Byron saw 12 or 15 together in one group, evidently a mating assembly for picking their partners.

On March 18, 1923, at the same place, I found 12 Jacks in pairs—6 pairs clear-cut.

The habits of the European Hare afford corroborative evidence of the above conclusion. Millais says: "Like Rabbits, Hares never truly pair, although pairs may be constantly seen together. A strong buck consorts with a doe for a time, and then leaves her to look for another mate. The bucks fight savagely at times, and can deliver severe blows with their hind legs. They also drum on each other with their fore feet, and sometimes bite. Mr. Drane says, 'I once saw 2 Hares manœuvring, when one jumped over the other, so striking it with its hind feet as to disable it. The striking Hare instantly turned around, sat up, and drummed on its antagonist's body with its fore feet. During the battle, there was no sound but that of the blows. My curiosity induced me to intervene. I picked up the vanquished Hare—it was dead.'"[1]

[1] Mamm. Gt. Br. & Ire., III, p. 12.

In my home park, I kept Kansas Jackrabbits for a number of years; and twice at least, saw 2 males fighting in this very way—up on the hind legs, boxing with front feet, and each seeking a chance to leap over the other, and treat him to a "savate" from the powerful hind feet. During the fight, one of them kept up a loud "gua, gua, gua," in a deep, hoarse tone. I do not know whether it was a war cry or a plea for mercy. But nothing happened; no one was killed.

Even in Kansas, I found this Jackrabbit mating as early as Feb. 10th. February and early March may be considered the mating season.

The Nest That Has Never Been Seen

In all the millions—yes, billions of times—on the million-mile range that Jackrabbits in the breeding season have been seen, hunted and shot, with their young ones running or unborn, never once, so far as the record goes, has anyone had the luck to find a Jackrabbit's nest with young in it.

This brings up the question: Does it make a nest at all? The European Hare apparently does not, and I am compelled to believe that our Jackrabbit also makes no nest. It hides its young in a thicket till they are able to run; hides them, not in a spot, but in a locality; and usually but one in each place. The time of hiding is probably only 3 or 4 days.

In the management of the young, we must again refer back to the European Hare as analogy, since we have no definite records of our own. Millais says:

"Soon after the production of her young, the Hare moves her family about, and will place the various individuals in different forms, visiting each at night at different times. It may be that this habit of scattering her progeny in ones and twos, has led to the belief that she usually possesses only 1 or 2 young ones. The Rev. E. A. Woodruffe-Peacock says: 'This regular dispersal of their young into suckling forms soon after birth, is performed at night, and very rarely witnessed. I have never seen it, but was informed that they are carried as a Cat does her kittens!' . . . The mother in every instance took her progeny one by one, and deposited them in separate places in the paddock, subsequently visiting each in turn to suckle it. On the whole, it must be concluded that the Hare is far more prolific than it is supposed to be."[2]

The Multiplicand

The young vary in number from 1 to 6—never more, and even 6 is rare. The average number is 3, but 4 is common; nevertheless, these figures rest

[2] Mamm. Gt. Br. & Ire., III, p. 13.

wholly on prenatal counting. On March 8, 1922, at Victorville, Calif., I received a female Jackrabbit, killed by a motor car. She contained 5 young, fully furred and ready for birth. This is the largest number I, personally, have known.

In the South, they are born at any time from early February to late September; that is, every month in the year except October, November, and December. In the northern part of their range, this breeding period is shortened at each end by a month or more.

The fact that young are born every month but three, does not prove that each mother has half a dozen broods per annum. It is likely that each has one, or at most two broods a year, as will be shown; but of this we have no positive evidence at all. There does not seem to be anywhere else in the world, an animal so abundant, conspicuous, and familiar, concerning which so little is known.

In the spring of 1926, I imported half a dozen Jackrabbits from Kansas. On March 27th, the day after arrival, one of them produced 4 young, fully furred and well developed—eyes open—but dead. They weighed respectively $2\frac{5}{16}$ oz., $2\frac{1}{4}$ oz., $1\frac{14}{16}$ oz., $2\frac{1}{4}$ oz. Sexes not ascertainable. Their coats showed exactly adult pattern; 3 had white blazes on the forehead.

How They Grow

The only observations at hand on the development of the young Jackrabbit, are those by Mary C. Dickerson. They are so complete and important, that I cite them nearly in full.

She was then attached to Leland Stanford University, Calif. Her observations appeared in the *Natural History Magazine* of the American Museum, as follows:

Feb. 25th. "I was at my desk in the University laboratory, my back to the window with its view of mountains and foothills. Suddenly there was shouting, and a rush of feet on the campus outside. Three labourers were chasing and stoning a Jackrabbit. Soon they had it cornered in an angle of the buildings, and were about to use a club. It was the work of but an instant to reach the door, and by a bribe, change the intention of the man with the club. So the Rabbit was caught unhurt (not without the expense of numerous long scratches on the arms and hands of the captor), and was soon in a Rabbit house improvised from a packing box. She did not give up her freedom without further struggle; but between the periods of bewildering activity and thunder of hind feet on the wood of the box, she looked out from her temporary prison with large, gentle eyes.

PLATE XCVI.—PORTRAIT OF A KANSAS JACKRABBIT

Photo. by E. T. Seton

"The next morning (Feb. 26), on entering the laboratory, I chanced to observe a small, brown oval patch in a corner of the room. Bending down over it, I saw two large, luminous eyes gazing mildly at me. It was a baby Jackrabbit, so small that it could be held, I found, and partly covered in one hand. Diligent search of the room disclosed one other baby Rabbit in the farthest corner under the radiator—a family of two. Both together could be held securely in one palm, and they showed little fear and no desire to leave the spot.

"The California Jackrabbit (*Lepus californicus* Gray) is born in an unusually advanced condition. The young Rabbit is covered with fur, his white teeth are cut, and his eyes are wide open. His coat is brown, with accents of yellow and black, much richer in colouring than the grayish fur of his mother; and he is labelled a very young baby Jackrabbit by a light gray area which surrounds his mouth and his brown wiggling nose—like a round bib tucked above his chin instead of below.

"On comparison, he scarcely seems the son of his mother. His ears are not half the length of his head, whereas hers exceed the head in length by 2 inches. Also his muzzle is short and broad instead of long and pointed like hers—in fact, his face is ludicrously flat below the eyes, as though he were really as soft and plastic as he looks, and had received a gentle but convincing blow on the nose. And thirdly, his short, stocky legs would certainly classify him as the offspring of some other Rabbit than a Jack.

"But these are all items of his immaturity. By the 10th day, the ears and legs begin to lengthen out of proportion to the increase in growth elsewhere, and his muzzle also begins to lengthen and narrow. The changes in the shape of the muzzle and in the length of the legs are gradual; but the growth of the ears from this time on, is astonishingly rapid. At the 15th day, they equal the head in length; soon they outstrip it, until at the close of the 4th week, they are 4 inches long; and at the end of the 5th week, measure $4\frac{1}{2}$ inches, whereas the head is then only $2\frac{3}{4}$ inches in length. It is amusing to see Baby Jack take advantage of this increased length of his ears to haul them down and wash them conveniently in his mouth—he has the instinct to wash his face from the first morning of his life.

[Note that in the young Jackrabbit a month old, the ears are proportionately longer than in the adults. In the young Cottontail, they are very much shorter.]

"During the first days, Jackrabbits have a generalized sense of fear, squatting with lowered ears at any sound or movement; also they have a bravado not possessed later, turning and jumping at the enemy in pugilistic fashion, while expostulating in a harsh, low-pitched voice. Later, their fear

becomes very definite and vivid, yielding not a jot to months of care and captivity.

"One of the most conspicuous signs of a Jackrabbit's babyhood lies in his inability to gauge perpendicular distances. For the first few days, his instinct keeps him pretty closely to the ground nest; otherwise he would try to walk downhill as though it were level, or would unwittingly walk off any rock or hillock, and so might get many a tumble. It is not until the third day that he begins to be cognizant of the ups and downs of his world. His development is rapid, however, and 24 hours later he stops and studies every situation.

"On the 4th day, he begins digging; and from this time till he is 5 weeks old, spends much time in this employment. Serious-eyed and absorbed, he works very hard—like all young animals he is 'dead in earnest.'

[It is exceedingly interesting to note that the young Jackrabbits go through a digging stage, suggesting that such was the way of their remote ancestors. But they entirely give it up later and conform to the custom of the race: no adult California Jackrabbit has been known to dig or enter a burrow.]

Play Is the Business of Childhood

"Jackrabbits have the play instinct from the first day. In this case observed, play activity increased steadily from the 4th day to a maximum at the close of 2 weeks, then continued, apparently without change, except as influenced by increasing muscular strength. Playing Rabbits are intensely alert. When facing away from each other, suddenly, with what seem simultaneous leaps a foot or more in the air, they are turned about touching noses. They bound away in devious curving and zigzag courses, moving with indescribable lightness, and stopping with startling abruptness. One jumps at the other 'pell-mell'; he, in turn, shoots straight up into the air, dropping to a listening position with long ears held far forward, very Deerlike. Again, they take to following the leader; one jumps over a stone, the other follows: the first leaps a chasm 2 feet wide, the second is at his heels; they crouch in the shadow of a stone, then dash out into the light, capering; then peer out from the shadow again where they remain, momentarily interested in washing each other's faces. Soon they are playing boisterously again, one bounding into air without any preliminary hint of such an intention, the other shaking his head until his long cartilaginous ears snap together. Finally, one of them sees something that stimulates his curiosity. He watches eagerly, his ears straight forward and widely opened. He progresses a little, he drops one ear, he moves slightly to the right, to the left, he stretches slowly forward, in-

vestigation written plainly in eyes, ears, and tense muscles. Ah! it's only a shadow after all, and Bunny Jack races away, lowering his tail, so that it is like a little black streak between his flying hind legs.

"The most surprising thing about young Jackrabbits, in the light of the fact that they are so highly developed when born, is their continued dependence on a milk diet as the weeks pass. On March 2d (6th day) they showed the first recognition of the possession of teeth by chewing at the nest material. When 2 weeks old (March 10th), they gained their first interest in grass, sniffing at it with noses a-wiggle, and little red tongues thrust out at right or left, but refusing to eat more than one or two of the grass ribbons. The 3 weeks limit was reached (March 17th), 4 weeks were gone (March 24th), 5 weeks (March 31st), and the situation seemed astounding. Six weeks (April 7th), at last they showed willingness to eat clover and grass. During the 7th week, they were weaned from their improvised 'bottle'—most unwillingly on their part—and with the change in diet, became increasingly wild."[3]

This long period of dependence on their mother is a surprising and interesting fact. It is definite proof that the oft-asserted 3 or 4 broods per annum are an impossibility. For the time of gestation is about 30 days, the raising of the young 40 days at least, rest period before the next heat at least 30 days, a total of 100 days. So that in the South, the Jackrabbits may have 2 broods in the season; but I doubt much whether in Kansas and Colorado, they have more than one.

The problem, however, is further complicated by the possibility suggested in the following observations on the European Hare:

"A curious fact is that the ovaries are capable of superfoetation; on many occasions, unborn young of different ages have been discovered."[4]

The Nursing of the Young

In the total absence of information as to how the mother Jackrabbit cares for her young, I offer some testimony as to the ways of the European Hare, which will at least show us what to look for. The Rev. E. A. Woodruffe-Peacock says: "The guttural pipe of the doe, and the minor key of her young, as she passes from one milking form to another, are well known sounds of the evening and early morning in the country where Hares abound."[5]

Again: "While seeking information on this subject," says Millais, "I

[3] Jack-rabbit in Calif., pp. 71–74.

[4] Millais, Mamm. Gt. Br. & Ire., III, p. 12.

[5] Cultivation of the Common Hare, p. 10, quoted in Millais' work, p. 14.

received the following note from Sir Richard Graham, who is a great Hare preserver: 'Bell (a very intelligent keeper on the Netherby estate) tells me that the doe Hare has a very peculiar sort of a noise she makes when she has young. It is something between a grunt and a whistle. He says that it is possible to hear the doe quite distinctly at a distance of 300 or even 400 yards. He also says that she runs the scent of her young ones just like a Dog, and she utters the cry as she goes along. She will also sit still and bring the leverets to her side with a similar call.'"[6]

Solitary and Selfish

Jackrabbits may swarm in certain regions, but they are never sociable or gregarious except when mating. No one ever saw a flock of Jackrabbits keeping together, and obeying some common impulse that was binding on their movements. No one ever saw a colony of Jackrabbits—that is a thicket or any other limited area in which a score of mothers had their young assembled for protection. No one ever saw two or more Jackrabbits combining to achieve some common object. Therefore the Jackrabbit is essentially solitary not to say selfish, which amounts to the same thing.

Communication and Voice

Sociable animals have most means of communication; therefore the Jackrabbit should have but few, and these of poor development. Be it noted first, so far as known, the Jackrabbit does not signal like the Cottontail by thumping with his hind feet. His vocal signals are but few, so far as I have seen. Outside of the warwhoop, already described and the loud scream of terror given occasionally when caught, I never heard my Jackrabbits make any sound. Nevertheless, we are here confronted by the handicap of wholly inadequate observation.

So far as I have seen them—and my opportunities have been good—the Jackrabbit and the European Hare are very similar in habits and in gifts; therefore I again incur the risk of using sidelight, by quoting from Millais on the habits of the European Hare, believing that ultimately we shall find these same habits obtain in our Jack.

After noting the grunting and hissing of Hares in combat, the Rev. E. A. Woodruffe-Peacock says: "Hares also make other sounds—love calls and a warning call. The latter is like the peculiar stamping with their hind feet of Rabbits, in its result. It is undoubtedly produced by the grinding together of their teeth. This sound always puts every Hare within hearing

[6]Mamm. Gt. Br. & Ire., III, p. 15.

PLATE XCVII.—A CALIFORNIA RABBIT DRIVE

Photograph by H. H. Alexander

on the alert for danger. It may be distinctly heard in a well-stocked country by placing the ear against a dry gatepost, and then touching the gate so as to make the latch rattle. The sound is then taken up and passed on from Hare to Hare over a wide area."[7]

Similarly in the same work (p. 15): "Messrs. Mann, of Aigle Gill, possessed a female Hare which on summer nights would call softly to a wild jack Hare which came to visit her. They used to call to each other in low and plaintive tones."[8]

As already noted, the mother Hare has a peculiar call with which she can assemble her young.

"Captain Brander-Dunbar likens the call of the doe Hare to the bleating of a lamb. Mr. [Robert] Drane, of Cardiff, writing on the voice of the Hare, says:[9] 'Both sounds (of fear) are uttered with wide open mouth, and resemble the repeated word "*arnt*" or, if you will, "*aunt.*" I believe that this is the only open-mouthed voice of the Hare. But it emits other sounds with a variety of meanings, with closed mouth, which resemble our contraction "*don't,*" "*oont,*" and "*ont.*" I can always make my Hares say "*don't*" as we say "*hump,*" without opening our lips, when we mean to indicate incredulity or contempt. This is done by a quick movement of the hand, as if to seize the creature suddenly. If the same movement is made slowly, no sound is emitted. This exclamation is a very clear "*don't,*" but not loud; it is, indeed, often only just audible. That is when one does it often, or repeatedly at one time to a Hare which is so perfectly tame that it knows no harm is threatened!' "[10]

While these observations do not prove that our Jackrabbits do the same thing, the fact that the two species are near kin makes it probable. At any rate, we have not at present any evidence to the contrary.

Strange Incidents

This last section reminds us that the Hare is the emblem of timidity, the visible embodiment of it, and the Latin name of the European species is *Lepus timidus*. The following incident from the pen of W. B. N. of Tucson, Ariz., concerning the present species, is an illustration in point. It shows the taming power of fear.

"The other day, when driving in the Cattle, the herd evidently trapped and surrounded a Jackrabbit. I was driving them along, from behind, and

[7] Cultivation of the Common Hare, p. 10, quoted in Millais' work, p. 14.

[8] H. A. MacPherson, The Hare, Longman's Fur, Feather and Fin Series.

[9] London Field, March 25, 1905.

[10] Mamm. Gt. Br. & Ire., III, pp. 15–16.

saw it come crawling out, ears flat back, and evidently scared to death. If I had been on foot, I believe I could have quite easily picked it up by the ears. I first saw it picking its way along, dodging their hoofs. It was crawling so flat to the ground that I did not recognize it at first as a Jackrabbit. After it had successfully emerged, and the last cows were well by it, it slowly recovered from its daze, lifted up its ears, and when we were 50 feet beyond, it hopped off in a natural manner."[11]

A Rigid Vegetarian

Like the rest of its family, the Jackrabbit seems to eat everything that is green, or grown by a green tree or herb. Every form of plant life in its region seems to provide it with food. And when the thrifty farmer came along, and dispossessed the sage and cactus to plant alfalfa and cantaloups, the Jackrabbit said: "Good! These things are much to my taste," and proceeded to commit the unpardonable sin of rabbithood—destroying man's property.

Here is the official indictment that followed:

"In the West and Southwest, Rabbits are destructive to watermelons and cantaloups, eating the young plants as well as the fruit. At Laredo, Tex., H. C. Oberholser, of the Biological Survey, observed that Jackrabbits had ruined an entire field of cantaloups when the plants were about 6 inches high, and had greatly damaged a field of watermelons. At Sequin, Tex., in Nov., 1904, Vernon Bailey found that about 75 per cent. of the watermelons in one field had been destroyed by Jackrabbits, and that cantaloups could not be grown except when protected by rabbit-proof fences."[12]

It is easier, perhaps, to list the things the Jackrabbit will not eat. It avoids fish, flesh, fowl, reptiles, and insects; never was known to cannibalize, or to eat creosote bush; and I never knew one to dig, climb, or swim for its food. It dislikes and avoids lime, sulphur, coal tar, and blood, when these things are used as smears to protect the bark of orchard trees.

The Drink of an Abstainer

The Jackrabbit does not drink. Oh, amazing creature! in view of all that is implied by "apple-jack," "jack-boot draughts," "Jack tar," etc. Dust-dry is his country, and his habit. Like many of the desert creatures, he finds in the juice of his food-plants, a sufficiency of moisture to mix his blood, or dissolve away his toxins.

Dr. S. M. Babcock, in his paper on *Metabolic Water* (see References),

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[11] Forest & Stream, Jan., 1920, p. 27.

[12] Rabbit as a Farm and Orchard Pest, by D. E. Lantz, Yearbook, Dept. Agr., 1907, p. 332.

shows that carbohydrates, fats and proteins may be chemically converted into 50 to 100 per cent. of their weight in water, by oxidation or molecular change, within the cells of the body.

Protective Colouring

The Common Jackrabbit, when squatting under a sage-bush, is simply a sage-gray lump without distinctive colour or form. His colour, in particular, is wholly protective; and it is usually accident, rather than sharpness of vision, which betrays the creature as he squats. But the moment he springs, he is wholly changed. It is difficult to realize that this is the same animal. He bounds away with erect ears, showing the black and white markings on their back and under-side. The dark nape is exposed, the tail is carried straight down, showing its black upper part surrounded by a region of snowy white; its legs and belly show clear white. Everything that sees him, is plainly notified that *this is a Jackrabbit.* The Coyote, the Fox, the Wolf, the Badger, realize that it is useless to follow; the Cottontail, the Jumping Rat, the Fawn, the Prairie-dog, that it is needless to flee; the young Jackrabbit, that this is its near relative; and the next Jackrabbit, that this may be its mate. And thus, though incidentally useful to other species at times, the sum total of all this clear labelling is vastly serviceable to the Jack himself, and saves him much pains to escape from real or imaginary dangers.

As soon as he squats again, all the directive marks disappear, and the protective gray alone is seen. In summary, when *sitting*, the Jackrabbit is *protectively* coloured; when *running*, *directively*.[13]

On my grounds where I keep various wild things, I startled a Kansas Jackrabbit, Dec. 20, 1926. He ran across the frozen lake; and, as he bounded zig-zag away, he flung his saddle blanket from side to side, exactly in the fashion attributed to the Antelope-jack. This was the first time I had seen or heard of it in this species, but have noted it several times since. Whether a protective or directive manœuvre, I do not know.

The Track—Its Story

Plate XCVIII (p. 750) shows the general features of the Jackrabbit track. Compared with that of the Cottontail, the Jack is larger, leaves a tail mark, the hind feet are not paired in speeding, the hops are longer. In the Cottontail, the hind feet are always paired, sometimes the front also. The Cottontail rarely clears over 6 or 7 feet, the Jackrabbit commonly covers 10 or 12. The longest I ever measured was in Kansas—15 feet clear.

[13] See Directive Colouration, by E. T. S., The Auk, Oct., 1897, p. 395.

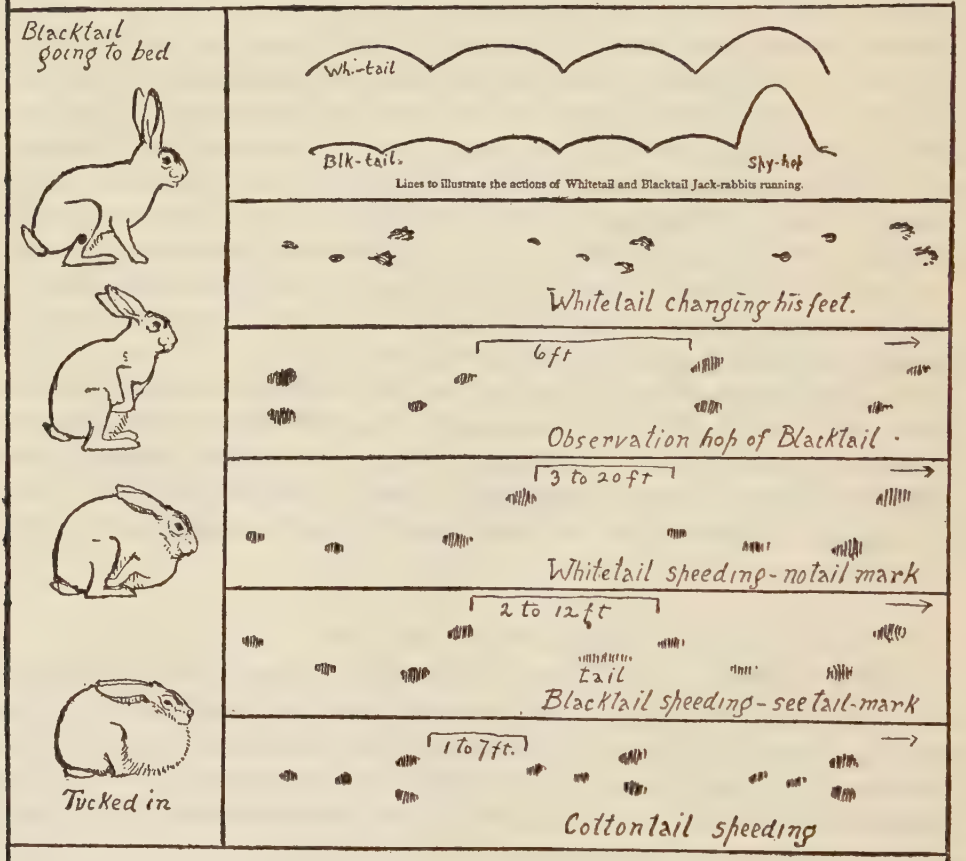

Plate XCVIII. Tracks etc. of Rabbits. E.T.S.

Enemies—All the World

Outside of the implacable, remorseless, and unreasonable arch-enemy of every living wild thing, the Jackrabbit has a long array supplied by nature on its most ancient range.

Among the birds of prey which "feed on Jackrabbits, are the barn-owl (*Strix pratincola*), Audubon's caracara (*Polyborus cheriway*), prairie-falcon (*Falco mexicanus*), and Western red-tailed hawk; but remains of the Texan Rabbit have been found in the stomach of the red-tail in only 3 cases among a large number examined. The Western horned owl (*Bubo virginianus subarcticus*) and the golden eagle (*Aquila chrysaëtos*) should also be mentioned. The marsh-hawk (*Circus hudsonius*) occasionally attacks Rabbits; and Mr. J. Alden Loring shot one at Vernox, Tex., while in the act of killing a young Jackrabbit which weighed a pound and a half."[14]

Chief among his four-footed enemies are the Coyote, Gray-wolf, Desert Fox, Gray-fox, and Bobcat. Skunks, Weasels, and Badgers may occasionally destroy the young, but seldom, if ever, the full-grown Hares. The Badger, an indefatigable hunter of the Groundsquirrel and the Prairie-dog, is too slow of foot to overtake the Jackrabbit in a fair race; and is unable to corner him in a hole, as he can a burrowing animal.

The Coyote is a most persistent rabbit-killer, probably the worst of all quadrupeds; and does far more destruction in this way than is generally known. The following notes show how this is effected:

"In trapping on the greasewood flats about Kelton, in northern Utah," says Bailey, "during the latter part of Oct., 1888, I noticed in many places that Jackrabbits (*Lepus texianus*) had been killed and eaten by some animal. The feet, bits of skin, and fur were usually all that remained; but I immediately attributed this destruction to Coyotes; and later on, was able to verify the conclusion by finding remains of Rabbits surrounded by fresh Coyote tracks. In a walk of a mile it was common to see where a dozen had been eaten; I could even see where the Coyotes had run and caught the Rabbits. The number killed was surprising, although both Rabbits and Coyotes were numerous. As I walked through the brush, Jackrabbits would jump up and run every few minutes, and Coyotes were frequently seen. In this particular spot, the numerous bunches of greasewood (*Sarcobatus*) scattered over the smooth valley bottom gave the Coyotes a great advantage, enabling them to approach close to the Rabbits and probably catch them before they got fairly started."[15]

[14] Palmer, Jackrabbits of U. S., p. 44.

[15] Jackrabbits of U. S., p. 45.

The bull-snake and the rattler must not be forgotten as enemies of the Jackrabbit. They continually prey on him, and are doubtless responsible for the disappearance of many of the young.

Insects and Other Parasites

But there are other enemies—smaller, yet far more deadly, than the fiercest creature Jack ever meets in fur and feathers. These are the host of insect and other parasites. Prof. E. Ralph De Ong, of the University of California, has given us a summary of the insect parasites found on Brush and Cottontail Rabbits.[16] The list includes wood-ticks, fleas, ear-mites, bot-flies, tape-worms, and a sporozoa. It is nearly certain that every one of these is also parasitic on the Jackrabbit; and that, in addition to its menace as a drain and irritant, is also provocative of a number of diseases, such as tularæmia which may be communicated to humans through handling the uncooked flesh.

In summarizing these, Dr. T. S. Palmer says:

"Jackrabbits are subject to epidemics, which occasionally reduce their numbers very materially. These outbreaks are more or less local, but are reported every few years. According to Mr. George Watkins, Rabbits were found in large numbers in Ash Meadows, Nevada, previous to 1891; but in the spring of that year they were very rare. He attributed the decrease to the prevalence of an epidemic, which had been so severe as to render these animals almost extinct. In northeastern California, Mr. A. C. Lowell of Fort Bidwell, Modoc County, mentions seeing many dead Rabbits in the autumn of 1893.

"A similar occurrence is reported by Mr. F. Stephens, near Beckworth Pass, Plumas Co. Speaking of a trip through northeastern California in August, 1894, he says: 'The epidemic among Hares was widespread through all the region I passed over north of Beckworth Pass, being perhaps most noticeable in the Madeline Plain on the South Fork of the Pitt River, and near the Nevada line south of Surprise Valley. In all these places I saw daily dozens of carcasses near the road. The only cause of death that I could see was the abundant warbles (*Cuterebra*) present in nearly all. It would seem, though, that these could only operate by lowering the state of health generally, and that some contagious disease was present.'

"Dr. J. A. Allen speaks of an outbreak that occurred in the vicinity of Great Salt Lake in 1870–1, destroying large numbers of *Lepus texianus* and *L. campestris*;[17] and Prof. Marcus E. Jones states that another occurred in

[16] Cal. F. & G., July, 1919, pp. 142–43.

[17] Monographs of American Rodentia, 1877, p. 372.

Utah in 1885 or 1886. A similar instance of the destruction of the Prairie Hare (*Lepus campestris*) has been mentioned by Mr. Gibbs and Dr. Cooper, which occurred in Washington north of the Columbia River about 1853.[18]

"Mr. Clark P. Streator, while at Pasco, Wash., near the mouth of Snake River, learned that another epidemic had occurred among the Rabbits in the vicinity during the summer of 1890. Maj. Chas. Bendire states that the inhabitants of the Payette Valley, Idaho, claim that epidemics occur among Jackrabbits in that region every 5 or 6 years."[19] Dr. Harris Garcelon, of Victorville, Calif., tells me that hæmorrhagic septicæmia is the epidemic that periodically wipes out the Jackrabbits on the Mohave Desert.

His Speed—His Way of Life

To run like a Jackrabbit is said to be the climax of speed; and it was a common saying among my cowboy friends, that you have a good Horse if you can follow a Jackrabbit so fast and so far that you can make him lay down his ears.

In the Antelope Life, I have given a scale of speed, founded on many observations. In this, the accredited rates are: Blooded Racehorse, best speed for a mile is at the rate of 34 miles an hour; Greyhound, 30 miles; Jackrabbit, 28 miles; Coyote, 24 miles. These, I know, are far below the popular estimates, but I have studied the matter for years, and am not disposed to change them. The Jackrabbit seems a wonderful speeder, but I have seen scores of Jackrabbits taken by Greyhounds; and know that, in a straight race, the Greyhounds can take the Rabbits within a few hundred yards. The one ruse that serves the Hare is rapid doubling. This will save him only if he can get out of sight. But usually, two Grey-hounds are run at once. The Hare, dodging from one, falls into the jaws of the other; and in the race when he has 50 yards' start, he is commonly done to death within 300 yards.

At Ash Fork, Ariz., March 6, 1905, I saw a Jackrabbit loping along easily. He made 20 hops in $5\frac{1}{2}$ seconds by stop-watch—that is, at the rate of 218 hops to the minute, and about 10 feet to each hop, making 720 yards per minute. His observation hops were very high—about 4 feet, I should say—and took three times as much time as the low bounds; that is, he could make 3 low bounds while he was taking 1 spy hop.

From my window to-day (Feb. 14, 1927), at a distance of 12 feet, I watched a Jackrabbit go to bed. I had had no idea of what a ceremony it is;

[18] Monographs of American Rodentia, 1877, p. 372.

[19] Jackrabbits of U. S., pp. 45–46.

it reminded me of "*le petit coucher du roi*," during the time of Louis XIV. Having selected a smooth, sheltered spot in the snow on the ice, the Jackrabbit posed himself with elaborate precision—this way and that—till the wind was right behind. Then he pulled in his neck, pushed forward his hind feet, raised up, and fluffed the nursery fringe till it spread outside his hind feet; then he swung backwards till his weight was entirely on his hinder feet and his padded tail was the cushion on which he sat. Next, he drew back his head, and puffed out his breast, so his fur collar partly wrapped his cheeks and ears. Then he bent his furry hands, and thrust them into his pockets—that is, the abundant wool fringe. His wrists were bent like knees upon this long fringe,—a carpet under them. In fact, he did pretty much as King Louis did on a rug for his "little prayer." Now, Jack wobbled his nose a little, flattened his ears on his back, sank his head deeper into his coat collar—and was at rest; maybe asleep. But I don't know. His eyes were open. It is said they sleep that way. *Quien sabe?* (See Plate XCVIII, p. 750.)

In the bygone days of the glorious West, when I cow-punched on the plains of New Mexico, the Jackrabbit was the common and happy little incident of a morning's ride. A dozen times a day, he would spring away from near the broncho's feet, and go bounding off in characteristic fashion—a few long, low springs, in each of which he covered 10 to 15 feet, then a high hop—a spy hop—a Kangaroo jump—up in the air to look around, just as did the Springbok of Africa. Away he would go, and many a day I yielded to the temptation to try my pony on him. A blooded racer, of course, could outrun the Jack, but a cow-pony was soon left behind. Over the nearest prairie swell would Long-ears go; and time and again, I followed, but saw him no more. His invariable plan seemed to be to cross the ridge, then squat again in some friendly cover; especially if he were disturbed when the sun was high, for he loves not the noon glare. In the evening, he is much more likely to keep on going; for, like all Rabbits, he is crepuscular—even nocturnal.

Numbers in Early Days

The dozen that I saw in a day's ride were, obviously, only those in the immediate track. Undoubtedly, there were many more that saw me, but did not leave their forms, or "beds," as we called them. This was considered Jackrabbit country; and I should say that 15 or 20 to the square mile was the largest probable number of Jackrabbits in the region. They seemed far less numerous than the Antelope in those days.

A hundred years ago so far as I can learn, the rate noted in New Mexico prevailed throughout most of the Jackrabbit country. This covered, in round

numbers, 1,000,000 square miles; that is, there may have been 20,000,000 or 30,000,000 Jackrabbits in those balanced and primitive days.

The Rabbit Menace

Then came a change, a sudden and appalling increase in the Jackrabbit population—a change which is variously explained.

One group maintains that the persistent warfare on Coyotes, Wolves, Foxes, hawks, owls, snakes, and other enemies of the Jackrabbit has so reduced these natural checks that the vast fecundity of the Rabbits has had its logical result.

Another group believes that the extraordinary multiplication is due to the unusual food supply afforded by the new and general farm crops; for sagebrush may be sufficient for one Rabbit to the acre, whereas alfalfa will support 20.

Still another group holds that many complex and imperfectly understood ecological factors are involved, of which two of the most important are the food supply and epizoötic diseases. At all times, the numbers of Rabbits have been enormously fluctuant, and while predatory animals and birds obviously reduce them to some extent, the predatory species alone are ineffective in controlling numbers when other conditions favour an increase. The Biological Survey experts hold to this view.

It is well to remember, however, that the predaceous animals are part of the chain that makes possible the deadly epizoötics. Such animals are essential as hosts and carriers of many diseases. So that the case is increasingly complex.

But the big fact remains that the Jackrabbits became multiplied to such legions that they threatened the new agriculture with destruction. In various parts of the West, plagues of Rabbits appeared; but it was in California that the damage was greatest. Here, in the San Joaquin Valley, the new-cult farmers found themselves facing absolute ruin at the instance of the myriad Jack-folk; and, in desperate self-defence, devised various new modes of destruction to meet the new peril. Among these were: the all-day shoot by the whole community, wholesale poisoning, and drives.

The Devouring Hosts

Some idea of the appalling multiplication of the all-destroying Jacks may be gathered from the following facts:

In the October of 1899, while collecting in the country about Bakersfield, Calif., I counted 20 to 30 Jackrabbits on every acre. Each tussock that

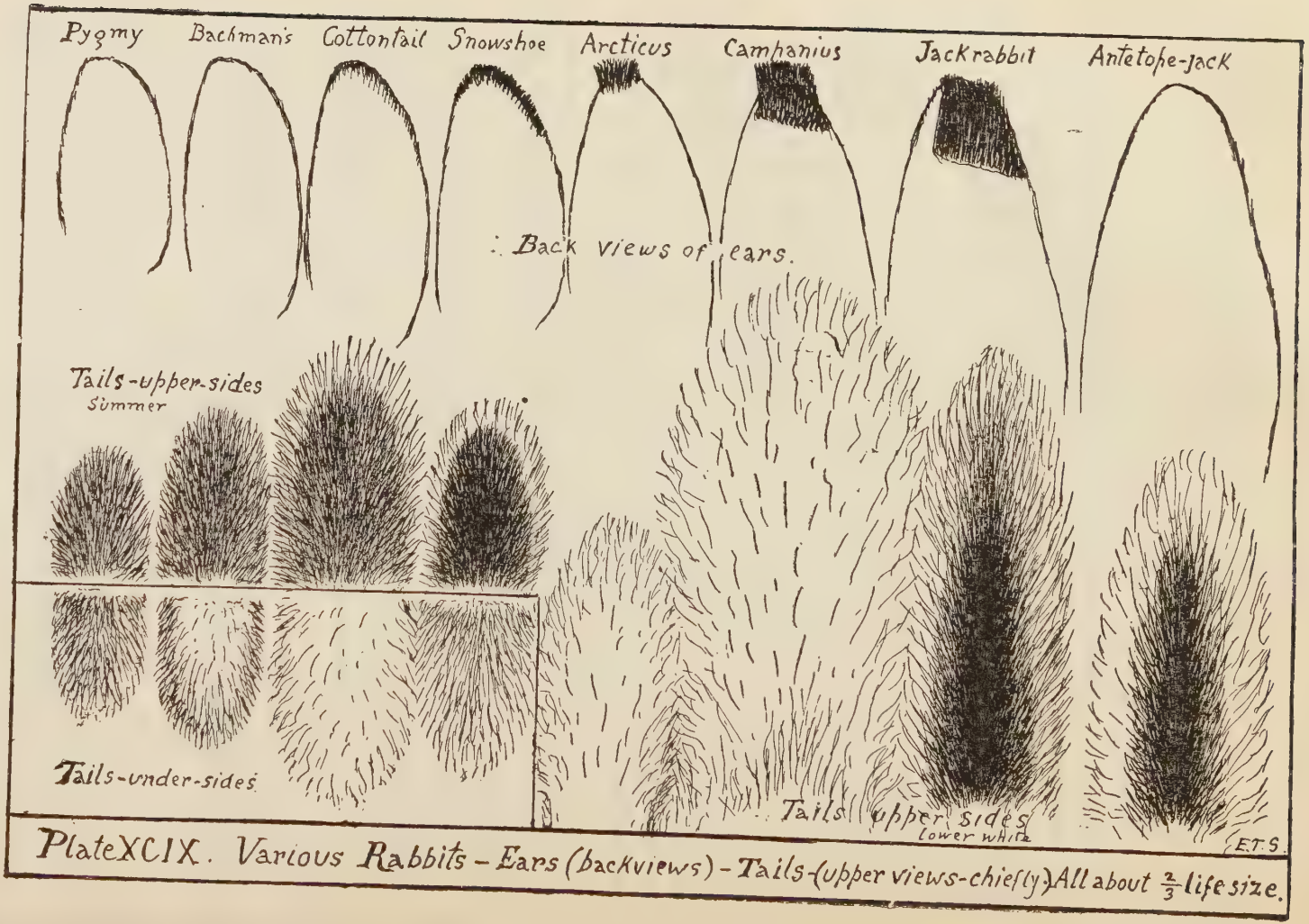

Plate XCIX. Various Rabbits – Ears (back views) – Tails (upper views-chiefly) All about $\frac{2}{3}$ life size.

I approached or threw a stone at, gave up at least one Bunny—a big, flop-eared Jack.

On July 17, 1906, Charles Payne, of Wichita, Kansas, was at my house and gave many data on Jackrabbits. He was catching them alive for the market, and had had vast experience. He worked with nets that enclose a quarter section of land (160 acres); and says that in Kansas, during a Rabbit year, the Jacks will "pan out" 200 to the 160 acres in favourable localities. Among the sandhills, he had seen 300 to the quarter section; and in other places, they were down to a dozen.

On March 21, 1923, I was on the Mohave Desert, near Victorville, Calif. I took a 20-minute walk around a low knoll, covering perhaps 10 acres. In that time, I saw 12 Jackrabbits. I have every reason to suppose that this fairly represented the population of the region—that is, there may have been 500 to the square mile.

"In Modoc County, northern California," says Palmer, "nearly 25,000 Jackrabbits were said to have been killed in 3 months on a tract of land only 6 by 8 miles in extent; this was during the period when the bounty law was in force. A still more remarkable case has been recorded in the San Joaquin Valley."[20]

Dr. Harris Garcelon, of Victorville, Calif., tells me (March 19, 1919) that on the Mohave Desert, the Jackrabbits are subject to the usual fluctuations. Great Rabbit years were the fall of 1910 and again in 1915. There were so many in 1915 that, during a 7-mile trip, he counted 148 sitting by the roadside; and in one afternoon, standing guard with a club over a hole in the wire fence around a cultivated field, he killed between 250 and 300. These were not driven; it was the ordinary traffic of every day.

Such figures sound high; yet, as noted later, according to Dr. T. S. Palmer, 8,000 Jackrabbits were killed in 9 days on a Bakersfield ranch that was less than a mile square.[21]

The Big Shoots

The "all-day shoot" of the whole community was early attempted as a solution that also offered a little sporting relish. These were the Western parellels of the Squirrel side-hunts of early days in the woods.

The "one-day's Rabbit shooting" at Lamar, Colo., by 200 guns, Dec. 31, 1894, resulted in the destruction of 5,142.[22]

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[20] Jackrabbits of U. S., p. 24.

[21] As above, p. 24.

[22] The Squirrel Hunters of Ohio, by Dr. N. E. Jones, 1898, p. 172.

At the same place, in a two-days' hunt in Dec., 1899, 6,000 Rabbits were killed.[23]

These are but samples of hundreds of similar yet mostly unchronicled, affairs.

The Poison Warfare

But poison proved much more effective. The farmers' clubs of Crook County, Oregon [7,756 square miles], succeeded in killing by poison 59,000 Jackrabbits "during the winter of 1916–17, making a total of at least 134,000 Jackrabbits killed in this county alone since the campaigns there were first undertaken."[24]

During the year ending June 30, 1921, the Biological Survey reports that "in Lincoln Co., Idaho, [3,270 square miles] 168,166 Jackrabbits (by actual count) were killed by the use of 845 ounces of strychnine applied to suitable bait. . . . In spite of unfavourable winter weather conditions for the poisoning campaigns planned in Oregon, 25,000 Jackrabbits were killed and counted, besides many others that were not found."[25]

The Drives

But by far the most destructive method is the driving—a systematic sweeping of the whole country by an assemblage of the whole population, arranged so that nearly all the Rabbits of the region are driven into the wings of a long chute, and ultimately into a corral in which they are slaughtered.

There were many drives of which no record was kept; but Dr. T. S. Palmer tells[26] of 155 in California during the 8 years, 1888 to 1895, which resulted in the destruction of nearly 2,400 Rabbits per drive, a total of 370,195 Rabbits. Between 1875 and 1895, there were 220 drives in the States of Oregon, Utah, Idaho, and Colorado, which encompassed the destruction of 470,107 Rabbits.[27]

"Some of the early drives near Bakersfield took place on a ranch less than 1 square mile in extent. In the first drive, on the afternoon of Jan. 2, 1888, 1,126 Rabbits were killed; as soon as the animals were dispatched, the same field was passed over again, and 796 more were killed. A week later, on Jan. 10, there were two drives on the same ground, the first resulting in the destruction of 2,000 Rabbits, the second in more than 3,000; in the latter,

[23] John Miller, of La Junta, Colo., Recreation, Jan., 1899, p. 45.

[24] W. B. Bell of Biological Survey, Yearbook, Dept. Agr., 1917, p. 10.

[25] Ann. Rep. Biol. Surv. U. S. Dept. Agr., pub. Sept. 10, 1921, p. 9.

[26] Jackrabbits of U. S., p. 58.

[27] As above, p. 64.

an adjoining field was also driven over. It was estimated that altogether about 8,000 Rabbits were killed on this ranch in 9 days.

"The Kern County *Echo* of March (8?), 1888, stated that a total of about 40,000 Rabbits had been killed in the drives about Bakersfield from Jan. 1, 1888, up to that date, and referred to an estimate that two-thirds of the Rabbits killed in the drives were females, and the average number of young of each of these was $3\frac{1}{2}$. On this basis it was computed that had these 40,000 Rabbits lived 2 months, they would have increased to 135,000."[28]

A Jackrabbit Drive

One of the most destructive of these drives is thus described by W. W. H. MacCurdy:[29]

"The Rabbit drive of the San Joaquin Valley is an institution devised and continued from year to year to keep the enemy in subjection. There are usually several drives in a season, the first in February or March, and the last early in April. . . .

"In the regular drive, men, women, and children, on foot, on horseback, in wagons, buggies, and carts, armed with guns, whips, clubs, and missiles of every description, participate. On the day appointed for the drive, all the roads leading to the various places of meeting, at an early hour, are thronged with the people on their way to join in the day's sport. The corral of the latest drive was located about 13 miles southwest of Fresno, near the line of the Southern Pacific Railroad. From this corral, following the general direction of the railroad track, ran about 5 miles of wire fence, poultry-mesh. A like fence ran southeast several miles. These fences served as leaders to bring the Rabbits into the corral."

The farmers then assembled in three great lines, each 4 to 5 miles long, and under management of mounted marshals. When this army—centre and wings—was placed, it enclosed about 20 square miles of Rabbit country; and the drive began. "From the time the lines began to move, Jackrabbits appeared, with here and there a Cottontail or a Coyote. The Cottontails and Squirrels took to their burrows as the line came up; but the Jacks, except in rare instances, trusted to their legs to take them out of the reach of club and bullet. . . .

"All the morning, the shotgun men have been getting in their effective work on the Jacks skulking among the weeds or hiding in hollows along the ditches. Marching along from 10 to 30 yards in advance of the line of teams and stick-wielders, like skirmishers ahead of a line of battle, they blaze

[28] Jackrabbits of U. S., p. 24.

[29] Recreation, Jan., 1899, pp. 17–18.

away at every Rabbit that comes within range. The plain behind the marching line is dotted with the carcasses of the slain.

"Every moment the number of visible Jacks increases, as they are routed from the weeds and grass, and sent scurrying across the plain. When the march first began, they appeared singly or by twos and threes; now they are in droves. Away to the Northwest rise up columns of smoke; the skirmishers have fired some tule-marshes, to drive out the cowering inhabitants. Shorter grows the line as the distance to the corral lessens; and denser becomes the swarm of frantic Jacks. The advancing line, doubled and redoubled in numbers as the enclosed area decreases, crowds the scared animals forward to the corral. The corral gate, only a few feet wide, furnishes a door of escape, and through it they pour in a solid stream, and spread out over its area.

"After the last Rabbit has passed into the corral, hundreds of men and boys rush in after them; the gate is closed and the massacre begins. The frightened creatures make frantic efforts to escape; they rush against the meshed barriers and along them, seeking outlet, until they become one great swirling mass, the sight of which makes one dizzy; they pile up in great heaps at the corners and die from exhaustion and smothering; they fall by the thousands under the quick strokes of their relentless pursuers.

"The slaughter complete, the mathematicians figure out estimates of the result. Oh the march, 50 Rabbits each to 300 shotguns—15,000; 5,000 killed by clubs and other missiles, and another 15,000 carted away from the corral; a total of 35,000 for the day."

These figures may be high, but we know that often half of this has been reached. And even at that—think of it! 17,000 soft, furry, little corpses! Terrible slaughter! But necessary if agriculture is to continue.

To-day

In southern California, where I saw such hordes of Jackrabbits in 1899, a different condition prevails, thanks to persistent warfare on the farmers' part. And I had supposed that elsewhere too, the Rabbit hordes were vanishing. However, Dr. A. K. Fisher writes me, March 29, 1927:

"In the West, to-day (1927) it is the same. Dry farmers are driven from their holdings. Live stock is being starved through the total demolition of stacks and growing forage by the Jackrabbit. Orchards and nurseries are being destroyed by ever-growing hordes of the devouring rodents.

"At Cedarville, Calif., during the latter part of Oct. 1926 (while I was there one Sunday), 6,000 Jacks were killed in a drive. In half a dozen

of the Western States, one of our perplexing rodent control problems is to prevent Jackrabbits from destroying farm produce, forage, and fruit trees. Hundreds of thousands of skins are being shipped to the East for felting in hat manufacture, without visible effect on the Rabbit numbers. Probably within a couple of years, we will have urgent requests to control Jackrabbits in southern California where, in 1923, you found them almost wanting."

So also Major E. A. Goldman writes me under same date: "In northern Nevada last fall, in a region little modified as yet by man and his works, I found Blacktailed Jacks so excessively abundant that they were seriously injuring even wild fodder, including the sagebrush. California Rabbit drives could have been duplicated there; they remain in similar abundance elsewhere."

The Final Thought

Thus, I have aimed to set before the readers a fair statement of the case of Farmer vs. Jack.

I never saw one of these Rabbit drives. I shall go if the opportunity presents itself. I know I shall rejoice in the oncoming mass of living, bounding, bright-eyed wild things. I shall follow and gloat over the visible abundance of life—till we get to the corral and the final scene. Then I shall turn my back and go elsewhere. I suppose that grim slaughter is necessary, but my memory sadly conjures up the bygone days when all the West was one great field of game. I ride the ranges of my boyhood days, and now I find no living wild thing. So that, seeing the Rabbit host—menacent, crop-ruinous though it be—I find myself secretly exulting that still there is wild life teeming in the West.

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LIFE XCVII—ANTELOPE-JACK

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Antelope-jack, White-flanked Jackrabbit, White-sided Jack, Blanket Jack, Saddle Jack, Mexican Jack, Mexican Jackrabbit, Burro-jack, Donkey-Jack, Texas Hare, Jackass Rabbit

Lepus alleni Mearns

(L. *Lepus*, a Hare; *alleni*, in honour of J. A. Allen)

Lepus alleni Mearns, 1890, Bull. Amer. Mus. Nat. Hist., II, p. 294, Feb. 21.

Type Locality—Rillito, Pima Co., Ariz.

"Antelope-jack" it used to be in Arizona, from the creature's general resemblance to the Pronghorn. Now it is "Burro-jack"; for the Antelope is fast becoming a thing of the past, a fading memory. As a simile, "Antelope" has lost all point; but the Burro, with his majestic ears, we have ever with us; and the name "Burro-jack" has a quick appeal, for it is dealing with familiar ideas, and it has the qualities of descriptiveness and patness.

When seen alive and afar, this superb creature seems simply a Jackrabbit of unusual size, exaggerated ears, and white flanks; a silver-gray animal with a brown mantle, a snow-white rear, and ears like wings. The absence of black tips to the ears, and the white which covers the sides—shoulder, flank, and rump—are strong diagnostic features of the species.

The Antelope-jack has, in addition to the generic characters, the following:

Size. Total length, $23\frac{3}{4}$ in. (606 mm.); tail, $2\frac{1}{2}$ in. (63 mm.); hind foot, $5\frac{3}{16}$ in. (131 mm.); ear from notch in dried skin, $5\frac{5}{8}$ in. (144 mm.). But the usual measurement of the ear from tip to notch is misleading, as, in life, this gives a length of only 6 or 7 in., whereas, by actual measurement from skull to tip of the ear, it is about 9 in.

Weight. Fresh specimens taken near Tucson, Ariz., in Jan., 1923, weighed $8\frac{1}{4}$, $7\frac{3}{4}$, $7\frac{1}{4}$, and $6\frac{1}{4}$ lbs. All were males.

Colour. In colour, the sexes are alike. The general impression is of a light gray animal, shading into pure white below. On the back, is a brown mantle or poncho through which the head is stuck; it passes around both

sides of the neck, and down the chest to the breast, where it hangs like a sharply defined bib. The mantle is plentifully peppered and flecked with black on the back; on the sides, the peppering fades away; the brown bib on the neck and chest is not peppered at all.

The underparts are white, which colour is carried up on to the sides—shoulder, flank, and rump—and shows more in the living specimen than in the skin.

The head is much like the mantle, with whitish rings around the eyes. The iris is yellow-brown. Under each ear on the neck, is a white patch. The ears themselves are speckled brown above, with a white edging on the outer side of each; and are, as we have noted, without the usual black spot at the tip. (Plate XCIX, p. 756.)

The legs are white with gray trimmings outside. The tail is ostensibly white, and issues out of a white region; but, down from the mantle—here blackish—trickles a little stream of black ink, which, though nearly lost on the white, finds its way on top of the tail to the tip; thus maintaining the black tail tradition of its group.

The Callotis Group

alleni Mearns, largest of all. T. l., Rillito, Ariz.

tiburonensis Townsend, like *alleni*, of which it is a race, but darker and more iron-gray; buffness on back, pale, and overlaid with black. T. l., Tiburon Island, Gulf of California.

palitans Bangs, like *alleni*, of which it is a well-marked race, but much more brightly coloured; skull, larger. T. l., Aguacaliente, about 40 miles southeast of Mazatlan, Sinaloa, Mex.

gaillardi Mearns, much like *callotis* in size and general appearance; but differs in having nape, plain buff, without a trace of black, and upper parts paler, more vinaceous buff. T. l., West Fork of Playas Valley, Grant Co., N. M.

battyi Allen, similar to *gaillardi*, of which it is a race, but smaller, and upper parts paler, especially on head and neck. T. l., Rancho Santuario, Durango, Mex.

callotis Wagler, a medium-sized species; hair, coarse; upper parts, dark, slightly pinkish buff heavily washed with black; ears, white behind; nape, black; flanks and underparts, white; rump, gray. T. l., southern end of Mexican table-land.

flavigularis Wagner, much like *callotis*, but back more grayish, creamy buff; ears, buff behind; two black bands on nape. T. l., probably near Tehuantepec City, Oaxaca, Mex.

altamiræ Nelson, top of head and back, creamy buff, thinly washed with black; ears, white behind; nape with a broad black stripe from the back of each ear. T. l., Alta Mira, Tamaulipas, Mex.

Thus, the group consists of 5 well-marked species, with the first 2 divided into 3 and 2 races respectively. These 2 species, *alleni* and *gaillardi*, are the only ones that so far have been found within our borders. The habits of the whole group are alike in the main.

Features

The gold-brown bib which hangs like a shield in front of the chest is backed by a skin of unusual thickness and strength, no doubt as a chest protector while rushing through the brush, or during the annual battles of the males.

The shifting of the mantle, noted later, is evidently done by the *panniculus*, or fly-shaker muscle; but dissection of several specimens showed that, though more extended than in other Rabbits, this muscle does not appear to be unusually large or strong.

On the belly, is a white nursery fringe, as described in the Blacktail Life (p. 737).

But his ears are his crowning glory—9 inches long, measured to the base, and 3 inches wide—the finest and relatively largest ears of any animal in America. (Plate CI, p. 771.)

On the under side of the ear, there is no fur; one clearly sees the fine-meshed veins and sentient membranes with their tingling nerve points. On all the upper parts, is a coating of very fine, close, brown hair, minutely peppered with black. Along the outer or lower side of each, is a marvellous bordure or "piping" of pure white velvet which goes right to the tip. On the opposite or inner side of the opening, is a fringe of coarse, whitish bristles, set like an exquisite comb.

One cannot see the creature crouched flat in its form, without realizing that, in this pose, these vast external ears are rainstorm roof rather than hearing apparatus. As he bounds away, they rise from the sides of his head like wings—the wings on Mercury's cap; and well may symbolize the creature's speed. But when one minutely examines the specializations and complexity of these wonderful external organs, one is forced to believe that they

PLATE C.—RABBIT STUDIES

A. The Four Styles,—Whitetailed Jack, Blacktailed Jack, Snowshoe, and Cottontail
B. Form of Kansas Jackrabbit
C. Blacktailed Jack crouching, now wholly protectively coloured
D. The same, bounding away, now directively coloured

are more than roof—more than ears—that they are carefully devised, developed, and perfected antennæ, intended to receive vibrations and wave lengths of many other kinds, as well as those we commonly call sound.

Range

The range of the Burro-jacks is, as shown on Map XVI (p. 607), the dry plains of the central Mexican table-land, from Sonora and Chihuahua on the north, with a slight invasion of Arizona and New Mexico, thence southward in the westerly part of Mexico to Chiapas on the Gulf of Tehuantepec. They range vertically from sea level at many places, to about 8,500 feet above, in northern Puebla. Faunally expressed, they fit into the Upper and Lower Sonoran, and into the upper border of the arid Tropical Zone—aridity having apparently more to do with their distribution than temperature.

Thus, these finest of the Jacks, these most intensified of all the group, find their home in the southmost part of the family territory, contrary to the rule; for, commonly, the extreme development of a group is somewhere near its centre of dispersal, or else in the coldest part of its range, where its food is, nevertheless, abundant.

Lepus alleni, that is here taken to represent its kindred, is found on the western coast belt of Mexico from Tepic northward through central Sonora, dying out as a long tongue thrust a hundred miles into central Arizona, reaching at least to Phœnix.

Haunts

There is no fundamental difference between the haunts of the Antelope-jack and those of the Common or Californian Jack. Independent of water, and averse to damp, they both seek the high, dry plains, where water and damp are practically unknown. Every little stipulation that the Californian Jack has made, concerning its home surroundings, has been adopted by the Antelope-jack; and insisted on in even higher degree, including the protection of scattering bushes. But the Blacktail is contented with soap-weed and sage; while the Antelope-jack, with larger ideas and larger problems, insists on an ampler defence against air attack as well as ground foes, and finds it in a fierce array of chollas and mesquite.

Numbers

As to its numbers, we have little information. The sum of that at hand shows the Antelope-jack to be scarce. The same melancholy sentence must

be written of it as of all the big game in our country—"formerly common, now rare."

Nowhere in the United States except in Arizona, was it ever a regular game animal. Discussing its occurrence, Nelson writes:

"Formerly, the Antelope Jack-rabbit of Arizona was common on the plains about Tucson, where many were shot for rifle practice. They are now comparatively scarce in that district, and are never so excessively abundant as the common species of the West now and then becomes."[1]

It does, however, become numerous as soon as its deadly enemy, the Coyote, is suppressed, as the following shows: In 1922, the farmers north of Douglas, Ariz., were so much pestered by Jackrabbits which had greatly increased since the Coyote-poisoning campaign, that, in March, they organized a drive. In one day, they covered a region 3 miles wide and 5 miles long, rounding up and killing 2,000 Jackrabbits; the greater part were of the present species.

The next day, they drove the same region, and still found the creatures in considerable numbers, though markedly reduced. J. F. Kinney, of La Osa Ranch, was present at the first drive, but did not wait for the second to finish, so is not sure of the later figures.

The unevenness of their distribution will be seen in this: On Jan. 15, 1923, I travelled for 38 miles south of Tucson, on sage plains, and saw not one Antelope-jack; then, in about 50 acres of woodland, saw 40 in 1½ hours. Again, on Jan. 22d, I travelled 50 miles southwest of Tucson over ordinary Cattle range, and saw not one; then, in a low woods of a mile across, saw 20 or 30 in an hour.

Home Range

There is very little light available on the home range of the individual. The Hares are everywhere noted for their adherence to their native soil and their routine life. This, being a true Hare, likely conforms to the family habit. We know that a square mile covers the home range of a Californian Jack, so that it is probable that the Antelope-jack may remain contentedly all his days in a region of less than 2 square miles.

There is a suggestion of light in the following: "When driven from the forms," says Nelson, "they often run in a wide circle; and in the course of half an hour or more, may be detected returning slyly and watchfully from

[1] W. A. N. A., p. 486.

a direction nearly opposite to that in which they departed."[2] That is, they do not go far, and they return to their small home range as soon as seems safe.

Mating

Rabbits are not held up as models of propriety in sex matter, as is attested by numerous rhymes, popular but unprintable. The Hares are probably on a slightly higher plane; and this is one of the most highly developed of the Hares. All high development tends toward monogamy; therefore, on general principles, the species should be monogamous.

Besides these broad considerations, the only light we have on the present subject, is offered by Nelson as follows: "White-sided Jackrabbits are frequently found in pairs, occupying forms in close proximity to one another."[3] Evidently, they have adopted the twin-bed arrangement.

Forms and Nest

It has been noted that the Californian Jack, like the Deer, has a place —that is, a locality—which it calls "home." But it does not make a nest for its young, as do the Cottontails. On the other hand, it does make beds, forms, or couches for its own individual use. These are scooped out under a bush or other cover, and are smooth, but not lined or otherwise tempered by art. The form of the Antelope-jack is much like that of its kinsfolk, but more modified to woodland life. From the number of forms seen, it is likely that each individual has several.

Again, the Californian Jack never makes a burrow, and never enters one except under stress and dire necessity, such as escaping or hiding from a foe. The Antelope-jack seems to be of another mind; at least, the following observations by Nelson would imply this:

"Like other Hares, the Antelope Jackrabbits occupy forms under bushes or in the shelter of little patches of coarse vegetation. The only exception to this rule I have seen, was west of the city of Guadalajara, on the Mexican table-land. There, one summer day, in the midst of a lovely open valley covered with short, velvety green grass, and dotted with scattered acacia bushes, a caracara eagle suddenly swooped down upon a young White-sided Jackrabbit. In mortal terror, the little beast dashed away at great speed, the caracara casting at it repeatedly from a height of 15 or 20 feet, and each time striking the ground just behind. The young animal ran not less than 500 yards, straight for a bush on a small bank, where it vanished as by magic.

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[2] W. A. N. A., p. 486.

[3] As above.

"The caracara was close behind; and, alighting, ran round and round the trunk of the bush, craning its neck, and apparently as surprised as myself at the sudden disappearance. Riding over to investigate, I found, partly concealed by coarse grass, the entrance of a burrow large enough to admit an adult Jackrabbit. It extended almost horizontally into the bank for about 18 inches; and then, turning abruptly to the left, ended in a rounded chamber some 15 inches in diameter, in which the young Jackrabbit lay snugly ensconced. It appeared altogether probable that this burrow had been made by the old Jackrabbit as a shelter for her young, one of which in its extreme need, had again sought asylum there."[4]

If this surmise be correct, then is the Antelope-jack the only one of the true Hares that makes a burrow underground—that has learned the wisdom of flying, when in trouble, to the bosom of Mother Earth. All animals, however, in dire extremity, will seek refuge in a hole, no matter what their normal habit. So that we await further light.

The Young

The young are, as with the rest of the group, 2 to 4 in number, rarely more. They are born ready to run. The following record is one of the very few that are available to show their time and way of life:

On March 30, 1920, Prof. Charles T. Vorhies, of the University of Arizona, shot a female Antelope-jack (*alleni*) on the Santa Rita Range Reserve, south of Tucson. When examined, 3 unborn young were found. Their eyes were open, and they began breathing normally at once. All showed a disposition to suckle, and might have been raised; but no foster mother could be found in time.[5] Which meagre facts show that its reproductive history is much like that of its kinsfolk.

Nothing further is recorded concerning the growth and development of this remarkable animal.

Enemies and Friends

The eagles and large hawks are dreaded enemies of the Jackrabbits on all the open parts of their range. But, the Burro-jack, when in shelter of the armed and haven arms of cactus and mesquite, has little to fear from anything on wings. Every flesh-eating quadruped preys on him, of course; and reptiles devour the young. Against all of these, the sufficient defence is the Jack's speed, his protective colours, and his fecundity.

[4] W. A. N. A., p. 486.

[5] Journ. Mamm., May, 1921, p. 114.

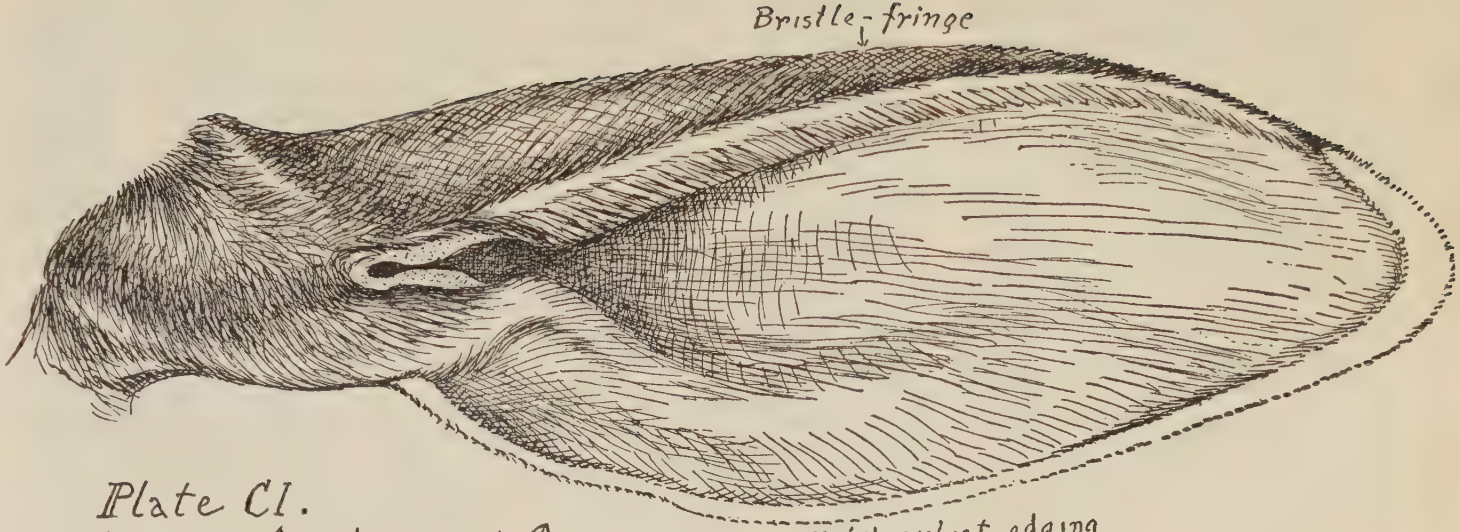

Plate CI.

Ear of Antelope-jack ♂

Tucson. Ariz. 15 Jan. 1923. Slightly reduced. E. T. S.

But the Coyote can go wherever the Jackrabbit goes, and his cunning ofttimes offsets the Jack's superior speed. J. C. Kinney, of Tucson, tells me that he has more than once seen the stratagem by which the Coyotes catch the far swifter Burro-jack. The pair—yes, the Coyotes usually work in pairs—go at an easy pace and follow the Jack; but keep on each side of him a hundred or more yards apart. The big white Jack goes bounding from the onset of Coyote No. 1, who is content when he has stampeded the Jack towards Coyote No. 2. As the fugitive comes near No. 2, the latter makes a determined rush, so the Jack is turned back at heart-breaking speed toward No. 1. That is, the Jack has to travel three or four times as far, and gets no chance to rest; while the Coyotes take it easy. At last, the Jack gets tired, the paralysis of terror sets in. The Coyotes close on him with a final rush, cut short his loud, hoarse "*qua, qua, qua*"—and the wise Wolves revel in their hot and bloody feast.

But the Blanket Jack's worst enemies are man and insects; against these two, his defences avail nothing. Rabbit drives, with their wholesale slaughter; motor cars, with their unfair speed; and long-range high-power guns that kill with certainty as far as one can see, are more and more in use against the doomed wild thing. He is nearly gone from the United States; his range in Mexico is shrinking.

The insect burden is evident on all sides, but of uncertain drain. Every one of the half-dozen Burro-jacks I have handled, had ears, face, and neck plentifully beaded over with seed-ticks—ticks that waste the frame by sucking the blood, and often repay their host by injecting into his impoverished veins the germs of fell disease.

Anyone who has travelled on the range of the Burro-jack, and realized the terrors of the myriad stinging, clinging, stabbing, clawing shrubs and vicious scraggly thorns, and the nightly need of tweezers to save him, body and limb, from the quills of these vegetable Porcupines, may well wonder if the Jackrabbits also do not suffer. He may ask, indeed, whether these grim, dagger-armed guardians do not sometimes, through life-long attitude or hostility, drive their poison poignards into the Rabbits that so long have looked to them for protection. The only present answer to this is that Coyote, Dog, Fox, Wolf, and many more are found with festering cactus wounds; but not one of the half-dozen Burro-jacks that I examined had a scratch or a hint of sting from any thorny plant.

Right marvellous is his speed, and seeming reckless in its impetuosity; yet, in the facts here given, we find ample proof that the Burro-jack knows what he is about—has learned the way of the cactus.

The Meteor of the Plains

As I watched one after another of these flashing "small Deer" go bounding by, I looked closely for the spy-hop or "Kangaroo-jump" that the other Jacks take when wishing to make an observation—to scan the world from a high lookout. But never once did I see it of the style that characterizes the Blacktail and Whitetail Jacks. At every fourth or fifth bound, the Burro did, indeed, make an exceptional leap; but its extent was forward, not upward. The reason is, no doubt, that, in the region where I saw him, he could not leap high enough to overtop the trees that are the cover round his home.

Nelson, however, is of the opinion that, in the open, they make spy-hops even higher than those of the Blacktail.

Sociable but Unsanitary

Nelson considers this animal as solitary as the Blacktail. Yet, on the day when first I met the species, I saw a pair, next 3 together, then 4, then 3 and 2 several times. Prof. Vorhies tells me that he has seen a string of 13 ambling along like Antelope; and this in midsummer, not the pairing season.

So far, I have little evidence that the Antelope-jack indulges in a dry-wallow, after the fashion ascribed to the Blacktailed Jack.

A first approach to the rudiments of sanitation is seen when a creature has a special place for the dung; the dung of this animal is scattered anywhere and everywhere in his haunts.

In other Rabbits, this habit has resulted in periodic epidemics. It remains to be seen whether the Burro-jack escapes the consequences of his ways.

Prof. Vorhies showed me a salt lick much frequented by these Hares. The deposit was of red clay, but I could get no taste of salt on putting it on my tongue.

His Way of Life

The Antelope Jackrabbit is the most intensified of all the tribe. Everything that a Texan Jack may be, the Mexican Jack is, in fuller measure. He is the biggest, longest-eared, farthest-leaping, brightest-coloured of all—the climax of the race. His, truly, are the wingèd head and the wingèd heels. Yes, and the wingèd heart, if we may gauge his zest of life by his superb bounding for the very joy of the mighty bound.

But persecution has made him scarce and shy. He is as hard to stalk now as an Antelope. Animals are usually shy in proportion to their size;

that is, in proportion to the pertinacity with which the meat-hunter pursues them; and this, the biggest of the long-eared Jacks, is, of course, the shyest of approach. He takes alarm mostly before the hunter is within gunshot.

Then, when he speeds away, as he has learned to do from anything that in the least resembles a man, he bounds so high, and makes such wonderful far-hops, that he gives a thrillsome picture of animal joy in animal power—an impression of a lithe, slick, and jubilant animalism.

And, as he goes, a baffling trick is seen. That big gray Jack turns into a white Jack as he sails away. Over some projecting ridge, he speeds in bounds of 20 feet. Then, if you follow softly, and unseen, and are equipped with good glasses, you may see afar the Jack—a Jack, but not a white one. This is brown; and only evidence—evidence in repeated abundance—will convince you that this is the same.

And herein lies the clue to his chameleon trick. By a muscular jerk, the buff gray mantle on his back was slid to the farther side; and the white of flank and belly drawn up, till all the side next us was shining white, and the other side mud-gray. Meanwhile, the black-topped tail was jammed against the rump, so only its outer rim, like a horseshoe of black, could be seen on the broad expanse of white. And the brown—whence came that change? Merely the broad brown ears upon his back, so positive that the gray was overpowered.

In the Californian Jack, we have seen the colour pattern used for alternately directive and protective colouration; but the Antelope-jack shows far higher specialization. Nelson, who first pointed it out, says: "The extension of the white on the sides of these species, assists in producing one of the most extraordinary examples of directive colouration known among mammals. I had the pleasure of discovering this one day in May, 1895, when hunting on horseback over the grassy plain bordering the Pacific coast of the Isthmus of Tehuantepec. As I rode slowly along, a big Jackrabbit hopped deliberately from its form in the grass a few yards away; and, by the contraction of a special set of muscles along the back, drew the sharp coloured dorsal area forward, and together, so that it formed only a narrow band on the middle of the back, with a corresponding extension of the white area on the rump and sides until, as the animal moved diagonally away, it looked almost entirely white.

"At a distance of 50 or 60 yards, it came to a stop, and expanded and contracted the dark dorsal area, thus producing a 'flashing' effect with the changing area of white on the sides and rump. This solved the riddle of the mirror-like flashes I had often seen, as Jackrabbits on the table-land had dashed away in the brilliant sunshine. The same habit of 'flashing' the white

was afterwards observed in the species of southwestern New Mexico and southwestern Arizona, demonstrating the appropriateness of the name 'Antelope Jackrabbit,' given them by the ranchmen."[6]

Again, this same experienced naturalist writes: "This enlargement of the white area is always on the side turned toward the chance intruder, and accordingly, alternates from side to side as the animals slowly zigzag away. In the bright sunlight, the snowy white side flashes brilliantly, attracting attention from afar, and affording a fine example of directive colouration.

. . . . . .

"One individual . . . hopped slowly from its form, not 10 yards away, as I rode by on horseback, and, standing broadside, shifted the buffy dorsal area over, at the same time slowly drawing the white area up like a curtain until the side toward me was pure white, except a narrow buffy like along the top of the back. The Rabbit then hopped slowly along in the direction I was riding, but gradually moved farther away, keeping the white area in the same position until it had travelled 50 or 60 yards, when the colour areas slowly resumed their normal positions. I have seen *callotis* zigzag along, changing its course every 10 or 15 yards, and each time it turned, it flashed the white on the side toward me. I am inclined to think this flashing of the white is most frequent during the rutting time."[7]

Why this amazing change—the reverse of what one might expect? For the creature was protectively coloured as he hid; and now, as he bounds away, is blazoned with colours that are revealing and directive.

No doubt, as already noted in the Blacktailed Jack, he hid and his colours helped him, as long as hiding was helpful; but now since concealment is no longer possible, he deliberately uses every label mark that willl make him known, announcing plainly to Badger, Wolf, Coyote, and Fox that "*This is an Antelope-jack.*" They know that his speed is far beyond theirs, so save themselves the trouble of following. They give it up as soon as they see, and the net benefit is chiefly to the Jack, for it saves him daily a vast amount of unnecessary effort.

Emphasis of this thought is found in the fact that as he bounds away, the Jack is careful ever to swing his blazing national colours to the side that is next the foe, even though this entail a swift flop-over at every other bound. And one individual that I saw on the Santa Rita Plain, went zigzagging bounding from us and kept jerking the brown mantle from side to side like the saddle blanket of a runaway Horse.

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[6] W. A. N. A., p. 486.

[7] Rabbits, N. A., pp. 115–16.

When Our Ways Met

My first meeting with the creature was on Jan. 15, 1923, near Tucson, Ariz. Prof. Charles T. Vorhies and family took me in their car to the Range Reserve, 38 miles south of the town, and at the foot of the Santa Rita Mountains.

On the road there, we passed much range that seemed suitable for the Antelope-jack, but never a one did we see. About 4:30, we reached a gently sloping country covered everywhere with the gold of the stiff dead grass; but thickly sprinkled over with feathery mesquites, alternating with the fantastic forms of sahuaro and barrel-cactus, prickly pear, chollas—woolly to look at and deadly to touch—catclaws and chaparral. Every tree and shrub in sight was defended with claws or poison, but everywhere the plain was spread with the gold of the precious winter grass. The country recalled East Africa, with its prairie slopes and wait-a-bits, the land of Giraffe and Baboon.

Partly wooded is the Santa Rita Range, and furnishes an ideal home for the wonderful Antelope-jack. Under every bush, the ground was pebbled over with the big, round "sign"; under, through, and among the low trees everywhere were the straight, narrow pathways of the Jack—6 inches wide —wonderfully straight when compared with the meandering trails of Kangaroo-rats and Cottontails; and flung across the land in one vast net.

Almost immediately, we saw a Jack under the ever-friendly thorn-bush, lying still and gray as a big gray clod, roofed over with two shingles, broad and brown. As we were in a car, he allowed us to come within 40 feet; a man on foot cannot get within 200 yards. When we stopped, he stood up on all four legs, high like a Deer. Now, the two broad shingles hoisted, became translucent, blunted spear-blades that blazed like wings of flame above his head; for the low sun was shining through them, and their blood-flush shone like wine.

Travellers in Africa have given an insight into their extraordinary mental reactions on first seeing the Giraffe. "What, that—a living creature! That tall, blasted tree, a thing of flesh and blood!" Though prepared for it, they were unprepared; and a shock, a joyful shock, is theirs, with the thought that follows fast: "And I am privileged to see this wonder of a by-gone day." Some such emotional overwhelm, in less degree, is the experience of those who, for the first time, see the Antelope-jack on his plains. He is so long, he sits so high, his ears are so enormous; and in the fantastic glamour of the desert setting and the evening light, he seems gigantic as he stands up-poised on those long, thin legs, like an Assyrian silhouette, or an Egyptian god incised on stone.

Plate CII. Details of Antelope-jack.

Another thought looms big as one gazes. "I am a part of all that I have seen," moaned an ancient and celebrated traveller, as though he thought that he had discovered a distressing condition peculiar to himself. As a matter of fact, we are, all of us—yes, every living thing—a part of all that we have seen and dwelt in.

The Antelope-jack is a part of all that he has seen. His daily life is among the weird and fantastic forms of the desert—the strange and wonderful growths of giant cactuses, suhuaras, yuccas, cresote bushes, fouquerias, palo verde—the towering mesas and pinnacles sculptured by the eternal sand blasts into forms cathedralesque, into mosques and minarets, devils' towers and dining tables; glinted with volcanic glass, rosy with vermilion, green-bright with copper-stain, impossible, wonderful, matching the bizarre vegetation unlike anything else on earth, and dry, dry, bone-dry.

In this, his native setting, the Antelope-jack is natural and at home. His extraordinarily long legs, long ears and long bounds, seem just what one might expect as the thing created of such and for such a realm unique.

The world about it is the mould in which Dame Nature cast the slowly flowing, mingled slag of each new race; and when the fluxed amalgam gets so cold that it no longer flows or bends, it breaks with any change. Is the Burro-jack confronting such a change?

On that memorable day, we saw about forty Jacks in the hour and a half that passed before the sunset, glorious behind the purple peaks of Arizona, gave place to dusk. Under the ragged, angular mesquite, the first one was descried, as we have seen. He rose, and for a moment stood, a statue of blazing white with red-hot ears up-cocked. Crack! and the vast, up-pent energy of his sinewy limbs was lashing in the death convulse.

One cannot but feel guilty as the struggle slowly ends. The bright gold-brown eyes still shine and seem to look. But his high-strung life is ended, the beautiful Burro-jack is a corpse. Yes, I can salve my conscience by saying that I will save his skin and skull for the museum; but that wonderful body will be thrown away. Here, indeed, are 1,000 cardinal facts bound up and offered in that snowy skin. But—thanks to my ignorance—I salvage only 2, and throw away the 998. May I be forgiven, and wiser men come by before it is too late.

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Cottontail, Cottontail Rabbit, Wood-hare, Wood-rabbit, Gray Rabbit, Molly Cottontail

Sylvilagus floridanus (Allen)

(L. *silva*, a forest; Gr. *Lagos*, a Hare; L. *floridanus*, of Florida)

Lepus sylvaticus floridanus Allen, 1890, Bull. Amer. Mus. Nat. Hist., III, p. 160, Oct. 8.
Sylvilagus floridanus Lyon, 1904, Smiths. Misc. Coll., XLV, p. 336, June 15.

Type Locality—Sebastian River, Brevard Co., Fla.

Mexican, *Conaro.*

The genus *Sylvilagus* (Gray 1867) comprises Rabbits and Hares whose young are born blind, naked, and helpless, to be nursed in a nest for a week or more before able to see and run. They have, moreover, many peculiarities of skull and of bony framework. All show the peculiar Cottontail pattern, described later.

Kinships

The latest authorities recognize 10 species of Cottontail, divided into 44 races.

For a study of life-history, it will, however, be better to assume one superspecies—the Cottontail—of which there are three well-marked groups:

The Common Eastern Cottontail (*floridanus*), largest of the 3; of a certain pattern described later, and general brownish colour; with 16 races and 3 closely related species described.

The Rocky Mountain Cottontail (*nuttallii*), smaller; pattern the same, but of paler buffy colours; with 3 races described.

The Desert Cottontail (*audubonii*), standard pattern still clear, but of very pale ashy or buffy colours; palest of all, with 12 races described.

Besides which, there is the *cunicularius* group in Mexico, with 4 races.

Those who wish to study their minute differences are referred to Nelson's monograph as listed.

The Common Cottontail (*Sylvilagus floridanus*), in addition to the generic characters, has the following:

Size. Total length, 16 to 18½ in. (406 to 470 mm.); tail, 1¾ in. (44 mm.); hind foot, 3 9/16 in. (90 mm.); ear, height from notch, in dried skin, 2 3/16 in. (55 mm.).

Weight, of specimens taken in northeastern New Mexico, ♂, 2 lbs., 2½ lbs., 2¾ lbs.; ♀ 2¼ lbs., 2½ lbs., 2½ lbs., 2½ lbs., 2 lbs. 10 oz.

Two ♂s bought at Duluth, taken in southern Minnesota, 2¾ lbs; and 3 lbs.

Specimens from Lorne Park, near Toronto, ♂s, 2 lbs. 12 oz.; 3 lbs. 1½ oz. (Feb.).

Specimen from Long Island, N. Y., ♂, 2 lbs. 3 oz.

A full-grown ♂ taken at Victorville, Calif., Mar. 19, 1923, weighed 2 lbs.

Note that the heaviest was a ♀ taken in February.

Colour. A specimen taken at Nyack, N. Y., Dec. 4, 1895, is coloured thus: All above, soft buffy, deepening into sienna on the crown, cheeks, nose, legs, collar, back, and upper tail; all below, pure white, especially the cotton under the tail. On the hip, a triangular patch of sienna which is an island on the pale buff of the flank; all above, peppered plentifully with black hair-tips. The sienna on nape, front of fore legs and back of hind legs very deep and pure without any peppering. Ear, grayish buff with whitish lining, and a thin blackish outside edging which is nearly complete. Feet, whitish with dull gray brown under-sides.

Otherwise expressed, this is the Cottontail pattern: A mantle of peppered brown, sharp-edged against flanks of peppered buff; a separate patch of back colour on each hip; clear white belly; legs bi-coloured buff and white, but not peppered; tail, back-coloured above, and white beneath.

This pattern is found in all the group; but is not found outside the group, excepting dimly in the near kinsmen, *aquaticus* and *palustris*.

Races

floridanus Allen, the typical form. T. l., Sebastian River, Fla.

mallurus Thomas, larger, with longer ears than *floridanus;* less black, and more reddish above; legs paler. T. l., Raleigh, N. C.

hitchensi Mearns, like *mallurus*, but much paler. T. l., Smiths Island, Northampton Co., Va.

mearnsii Allen, in size like *mallurus*, but much paler, and ears shorter. T. l., Fort Snelling, Minn.

similis Nelson, like *mearnsii*, but smaller, paler, and more grayish buff. T. l., Valentine, Cherry Co., Neb.

alacer Bangs, in size like *floridanus*, but paler and redder. T. l., Stilwell, Adair Co., Okla.

chapmani Allen, one of the smallest; like *alacer*, but grayer, with shorter ears, and slenderer feet. T. l., Corpus Christi, Tex.

holzneri Mearns, larger than *chapmani*, much grayer, ears larger, feet more heavily furred. T. l., Huachuca Mts., Ariz.

subcinctus Miller, much like *holzneri*, but smaller, and with shorter ears. T. l., Hacienda El Molino, Michoacan, Mex.

restrictus Nelson, like *subcinctus* in size, but much redder; rufous on legs, stronger than in any other Mexican table-land form. T. l., Zapotlan, Jalisco, Mex.

orizabæ Merriam, smallest and darkest gray of the Mexican subspecies; like *chapmani*, but darker. T. l., Mt. Orizaba, Mex.

connectens Nelson, large, nearly equalling *aztecus;* but with larger ears; general reddish colour. T. l., Chichicatle, Vera Cruz, Mex.

russatus Allen, of medium size, and reddish colours; with short, dark ears, and dark rufous legs. T. l., Pasa Nueva, Vera Cruz, Mex.

aztecus Allen, larger than *floridanus* or *russatus;* coloured like *russatus*, but brighter on hind legs; much longer ears. T. l., Tehuantepec City, Oaxaca, Mex.

chiapensis Nelson, largest of the races; pelage coarse; like *aztecus*, but darker and duller. T. l., San Cristobal, Chiapas, Mex.

yucatanicus Miller, much like *chiapensis* in size and colour; but paler and less intense. T. l., Merida, Yucatan.

cognatus Nelson, a large, gray species, much larger than *holzneri*, with large feet and ears. T. l., Manzano Mts., Valencia Co., N. M.

robustus Bailey, a large, pale species; grayer and much larger than *holzneri;* feet, large and thickly furred; skull larger than in *cognatus*. T. l., Davis Mts., Tex.

transitionalis Bangs, a small species, like *floridanus;* coloured like *mallurus;* but differing from all other Cottontails in the uniform pinkish buff or ochraceous of upper parts. T. l., Liberty Hill, New London Co., Conn.

The last 3 are considered distinct species.

Range and Northward March

Map XX (p. 785) sets forth sufficiently the vast range of the Cottontails in primitive times. But within 50 years, the Eastern Cottontail has greatly extended its holdings northward—perforce northward, since it came from the south, and had already spread from sea to sea.

The Ontarian invasion by the Cottontail is well known. In primitive forest days, the only Rabbit in Eastern Canada was the Snowshoe. Near Niagara, as Chas. W. Nash told me long ago, the Cottontail appeared first about 1871. Old residenters of Peel Co., near Toronto, told me that the Cottontails first appeared about 1872. In 1887, I found them regularly established, and common in Peel Co.

Writing of the species in Wellington and Waterloo counties, J. Dewey Soper says:[1] "This animal is not a native species, having entered Ontario with the clearing of the land sometime around 1870. Nash[2] first saw it along the Niagara River during the winter of 1871–72; while it was first recorded at Toronto, according to Fleming[3] 13 years later. Brooks, quoted by Miller in 1897, says that the Cottontail was common at Guelph, and that it had recently extended its range north nearly to Mount Forest. Today, it is relatively plentiful in suitable localities throughout both counties, and widely hunted in season."

Since then, it has steadily increased its territory, as the Snowshoe has retreated; and is now found, as indicated on the map, in all the Alleghanian region of Ontario.

In New York and New England, it has had a similar history. Formerly, it barely entered southern New York, Connecticut, and the southern border of Massachusetts. It has followed the settlements, and is now found throughout New York, excepting in the Adirondacks; throughout Connecticut and Massachusetts, and in southern Vermont. In New Hampshire, it is "abundant south of White Mts."[4]

In Maine, it is found in the "extreme southwestern" corner.[5]

In Michigan, it is now found nearly throughout the Lower Peninsula. M. M. Green records it for Montmorency Co.[6]

In Minnesota, it has spread from the Mississippi at Fort Snelling,

[1] Journ. Mamm., Nov., 1923, p. 245.

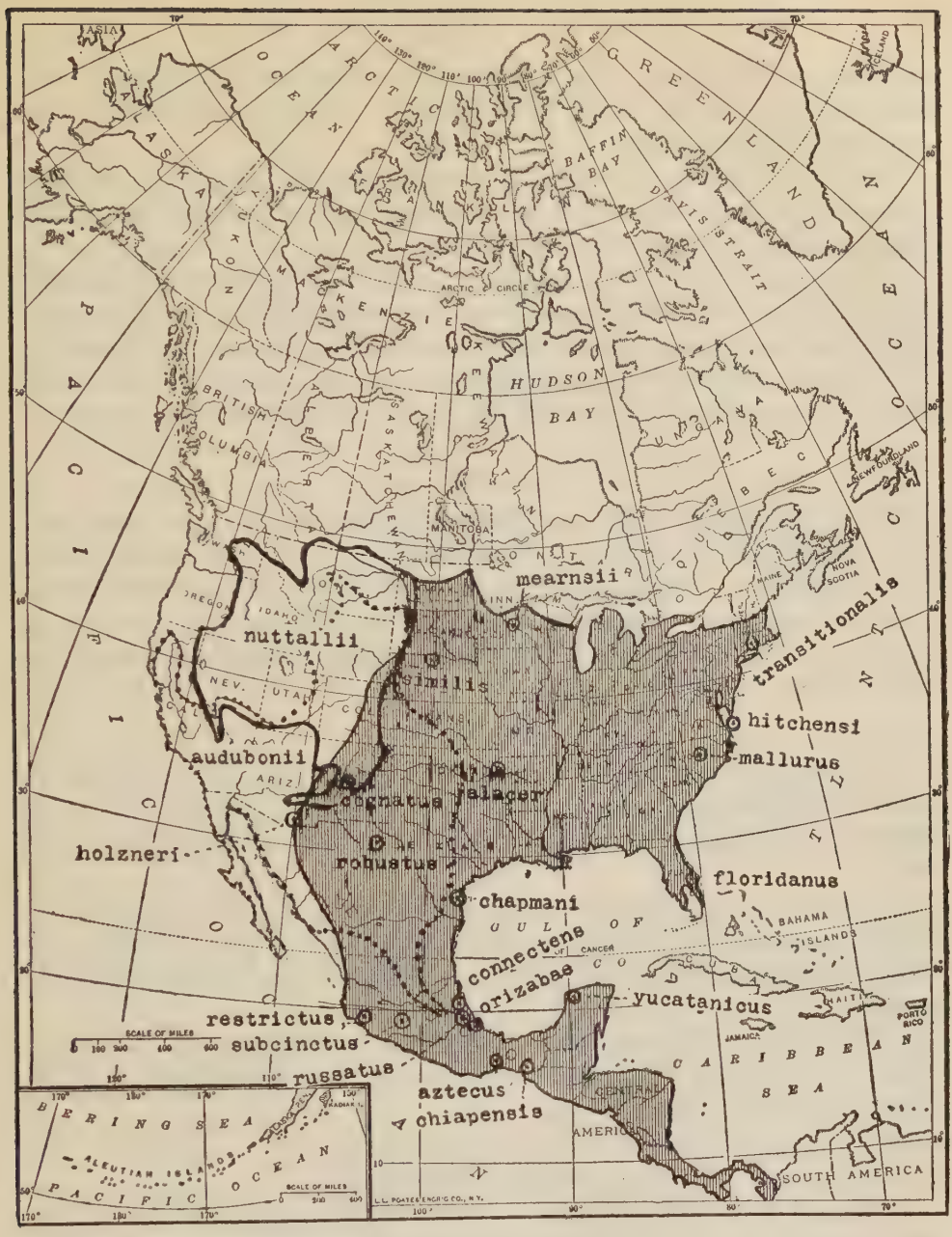
[2] Vertebrates of Ontario, 1908, p. 84.

[3] Mammals of Toronto, Ont., reprint, Nat. Hist. Tor. Region, 1913, p. 2.

[4] C. F. Jackson, Journ. Mamm., Feb., 1922, p. 15.

[5] Nelson, Rabbits, p. 196.

[6] Journ. Mamm., Aug., 1925, p. 178.



MAP XX.—RANGE OF THE COTTONTAILS IN NORTH AMERICA

By E. T. Seton, with assistance of the Biological Survey, 1927.

The range of the Common Cottontail (*floridanus*) group is given in tint. The range of the Rocky Mountain Cottontail (*nuttallii*) is in solid outline. The range of the Western Cottontail (*audubonii*) is in dotted outline. For fuller details, see Nelson's *Monograph of the Rabbits*.

northeastward to Duluth, where I found it occasional in 1908; and northward as far at least as Leech Lake. In 1887, according to Bailey, it had reached Fort Sisseton, S. D.[7]

It has not yet been recorded from Manitoba, but it is to be expected there; for it is a successful species everywhere spreading, and Manitoba is largely in the West Alleghanian Fauna.

In Saskatchewan, it has already appeared. P. A. Taverner writes me, Sept. 12, 1922: "We got Cottontails in the Cypress Hill country, in southwest Saskatchewan; also on lower Red Deer River in southern Alberta."

These records imply a northward extension east of the Rockies, of at least 100 miles beyond the boundaries shown in Nelson's map, 1909.[8]

Haunts

This is essentially a species of the borderlands, neither forest nor plain. It is fond of places overgrown with young pines, thickly crowded together, or thickets of briers and brambles. It rejoices in ill-kempt farms and plantations; and occupies, by preference, the coppices and grassy spots in the neighbourhood of cultivation. But it is not contented with a home in unbroken forest.

Small Home Range

All who have watched individual Cottontails closely, are struck by the smallness of their home range. I think it is probable that a Cottontail, unless driven afar by hounds or Foxes, spends its whole life within the limits of an acre.

It usually has a routine that it holds to for days at a time, following the same little paths, and feeding at the same places; so that, if you saw a Cottontail at a given place last night, you are likely to see it there again this evening.

Like all Rabbits, the species has regular pathways which it follows. These it incidentally improves by wear, as well as by cutting such new growths as tend to block them.

Freak Rabbits

Moose Bell. In the collection of James H. Fleming, of Toronto, is a belled Cottontail; that is, a Cottontail with a skin-bell on its throat (Plate CV, p. 805) much like that of a Moose. The bell is $2\frac{1}{2}$ inches long. The second figure shows the sections. Nothing is known of its origin or use.

[7] Trip Through Minn. & Dak., 1888, p. 446.

[8] Rabbits, p. 43.

Abnormal Teeth. Freaks with excessively grown teeth are common in the Rat and Mouse world; but, so far, I find but one case among the Cottontails. Dr. G. T. Runcies, of Roachdale, Ind., sends me the details under date of March 19, 1917. The picture (Plate CV, p. 805) speaks for itself. The history of such freaks is usually this: The incisors of rodents have persistent pulps, the teeth grow very fast and continuously, to allow for great wearing down through use. If the opposite incisor be broken, or, in some way, be prevented grinding on its mate, or if there be insufficient use of any one tooth, its growth continues unchecked till it becomes a sweeping half-circle or more, greatly inconveniencing the owner, or even causing his death.

In the Cottontail case here given, the lower incisors are present, and the explanation of the unusual growth is not clear.

Horned Rabbits. The horned Cottontail is a well-known freak. The horns are a morbid product of the skin, and seem to be the result of irritating attacks by a skin parasite. These growths are of no particular service to the owner; and will hardly be interesting until someone more fully explains their origin.

A specimen with 6 horns was taken by Jim Brennan, a rancher on Red Bird River, north of O'Neill, Neb.[9] One of these horns was 2 inches long.

Another Cottontail with 5 distinct horns—the largest $2\frac{1}{2}$ inches long, the smallest $\frac{1}{2}$ inch—was taken by Guy W. Von Schriltz, of Cold Water, Kansas, in Oklahoma, Dec., 1916.[10] A third, with but 2 horns, was killed on Salt Creek, Choctaw Co., Okla., 3 miles from Hugo, by Evans De Weese, of Hugo, about May, 1917."[11]

In Denver Museum (F. C. L. 3304) is a local specimen of Cottontail that has, all told, 15 horns. These consist of 5 well-marked horns from $1\frac{1}{4}$ to $1\frac{3}{4}$ inches long on the head; and 10 groups of low, horny points situated, 1 on the nose, 1 on the throat, 1 in each armpit, 1 on each flank, 1 in each groin, 1 on pubis, and 1 on rump. The head only is illustrated here (Plate CVI, p. 811).

An exaggerated case is one which I examined at Denver in the collection of William R. McFadden. It was killed at Stratton, Neb., about March 10, 1901. It had 16 horns distributed as follows: on the crown, 2; on the right cheek, 9 of various sizes; on the left upper lip, 1; on the chin, 1; on the rump, 3 of large size—that is, very thick and short, also irregular. The largest was that on the upper lip, $1\frac{7}{8}$ inches; that between the ears was $1\frac{5}{8}$ inches. All

[9] Forest & Stream, April, 1917, p. 162.

[10] As above, June, 1917, p. 261.

[11] As above.

were hard, rough, fibrous, and black, not unlike Antelope horns that have been weathered. This was the second horned Cottontail McFadden had seen.

Fur and Flesh

The pelt of the Cottontail has not yet found a place in the world's markets, for the skin is too tender for service, and the fur is deficient in the qualities of durability and gloss.

Its flesh, however, is everywhere in demand. Not to be compared with venison and sundry other wild meats, it is yet toothsome, nutritious, wholesome food. In the arid sage lands of the Southwest, the creature sometimes overdoes the sage-seasoning during its lifetime.

The Hunting of Molly

The Cottontail is the big game of the small boy. Be he trapper, chaser, or gunner, the first great triumph in his caveman life is usually the taking of a fat Bunny.

Found in nearly all parts of the United States, able to maintain itself on and about the farm—even on the prairies—this is the one game creature worthy of the name, that we have always and everywhere with us.

In the Northeastern States, the Cottontail is pursued with Dogs, and either shot on the run, or taken by hand from the stone wall, hollow tree, or Woodchuck hole to which it may have been driven.

In the Southern States, the creature is generally hunted with pointer Dogs, then routed from its form under the brushpile or the brier patch, and shot as it bounds away.

Bunny is wholly guileless in the matter of a trap. A snare placed on the trail, or in the gaps of some fence, is soon or late, the Rabbit's undoing. A box-trap with apple bait set in the barnyard or in the near woods, is another plan that every small boy uses.

Some game animals can carry a lot of lead. Deer and Bear can go a long way with a mortal wound; yes, a hundred yards or more, with a bullet in the heart. But the slightest touch of the deadly stinging shot tumbles poor Molly head-over-heels, to run no more. I know of no other creature of vigorous life that is more easily killed—that often dies, indeed, from mere shock.

Voice and Signals

Though furnished with a larynx and vocal cords, the Cottontail seems to turn them to little account. It signals rarely with its voice, and uses it but sparingly to express emotion. Every hunter is familiar with the long

squeal, "*qua-a-a-a*," that little Rabbits especially are ready to utter when caught; and most of us have seen the distressed mother come running to do her poor best for the baby in peril.

As later noted, the Cottontail that attacked the dead Skunk continued to utter his "*qua-a-a*" war-whoop.

Kennicott says "that, in fighting or playing together, the males produce a low, purring sound scarcely above the breath."[12]

F. and A. Brooks, writing on the weird nature sounds at night, say: "Quite rarely, the common Cottontail Rabbit, when startled at night, will utter a shrill whistle which many do not recognize; and there is sometimes heard from the woods in chill February evenings and nights, a long-drawn hollow trill which we have heard attributed variously to the Rabbit, Raccoon, and screech-owl. Undoubtedly, the screech-owl is the author of this note, yet we have been informed by experienced woodsmen that they have witnessed a Rabbit uttering the same sound."[13]

In my own Journal, I find the following: Greenwich, Conn., June 19, 1921. This evening, in Cow Lane, saw 2 Cottontails. Both stamped, and uttered a little squeak as they went off. This I heard twice quite clearly, and was within 15 or 20 feet of them at the time.

Most of their signalling is done by stamping with their hind feet. Anger, challenge, and fear are, in some degree, so expressed, because we get reactions in the other Rabbits who hear the thumps.

To some extent, also, the Rabbits use rubbing posts, that is, certain trees, stumps, etc., on which they leave their personal odour as a notice to other Rabbits.[14]

Molly's Meals

To make a complete list of the plants that serve the Cottontails as food, would mean a catalogue of 99 per cent. of the flora of the United States. Instead of offering such an array of names, I shall give a summary of their food habits, then deal with the exceptions.

Nearly every kind of green grass, succulent herb or flowering plant, native or foreign, is acceptable food to the Cottontails. Clover, wild and crop, and alfalfa are special favourites; growing crops of wheat, rye, peas, cabbage, and lettuce are eaten, though seldom in a degree harmful to the yield, because at that season other foods are abundant.

Shoots, sprouts, buds of growing trees and bushes, tendrils and leaves

[12] Quads. Ill., p. 79.

[13] Forest & Stream, May, 1921, p. 209.

[14] See Wolf Wireless, Vol. I, p. 286.

of vines are on the list; and, in the desert regions, the leaf buds of cactus, also the leaves and twigs of mesquite.

In the late summer, they eat berries, soft-shell nuts, cabbage, turnips, cornstalks; in winter, dry grasses, shoots of low bushes, field crops still on the land, leaves and bark of evergreen plants, and many kinds of trees.

What Rabbits Do Not Eat

This is a much shorter list. So far as I can learn, the Cottontails do not ordinarily eat such poisonous plants as hemlock, nightshade, etc.; nor do they eat toadstools. They care little for grain, and do not eat hard-shell nuts because they cannot. I never knew a Rabbit to eat burdock; and it is often said that burrs cause much trouble to these animals by getting in their wool. In the far Southwest, they do not eat the creosote bush. In the Californian forests, they commonly reject the incense cedar (*Libocedrus*), although exceptions appear. Prof. David E. Lantz says:

"The incense cedar (*Libocedrus decurrens*) of California, long reputed to be exempt from attacks by Rabbits, when planted by the Forest Service in the San Gabriel National Forest, was badly injured by Cottontail Rabbits."[15] This he explains as follows:

"Usually the apparent immunity of a tree from the attack of Rabbits is to be taken as indicating that other trees growing near it, are preferred; for when an entire plantation is of a single species, its apparent immunity often disappears."[16]

The Cottontails do not dig in the ground for bulbs or roots. Normally, they do not feed on flesh, fish, reptiles, or insects; and there is no record of Cottontails destroying bird-life in any form.

The Barking of Trees

Much calamity-howling has been heard over the barking of orchard trees by Cottontails. This raises a grave problem, but its terrors have been magnified.

There can be no question that Rabbits do cut off the twigs within reach. But this is a trifle, maybe no damage at all, for twigs so low are undesirable. Next, the largest proportion of the damage through girdling attributed to Rabbits is really done by Mice. In my own grounds at Greenwich, Conn.,

[15] Farm & Orchard, p. 333.

[16] As above.

PLATE CIII.—COTTONTAIL STUDIES

By E. T. Seton

Twelve Successive Shots in a Photographic Cage

nine-tenths of the rodent damage to orchard and plantation trees has been traced to Mice, chiefly *Microtus pinetorum.*

To a casual glance, the mischief done by the two is the same, but one can nearly always tell which was the criminal by certain features:

First, the wounds made by Rabbits have large toothmarks, and the bark next the wounds commonly hangs in strips.

Second, the Rabbit work is above the snow and up high; that of the Mice usually begins at or below the surface of the ground.

Third, the dung pellets are strong evidence.

Fourth, the tracks in the snow or dust are like criminal finger-prints.

Fifth, one might cite the probabilities as evidence; for they are 3 to 1 that it is Mouse work.

The Defence

Granting that the Rabbits are guilty as charged by the "howlers," there are three answers: (a) Destroy the Cottontails; (b) Protect the trees; (c) Compromise with the Rabbits—that is, make a treaty.

(a) Who would extirpate the Cottontails, even if he could? Who would rob the woods of a joyful flash of wild life? Who would rob the nation of an annual food supply worth $25,000,000? Who would rob 10,000,000 sportsmen of the one abundant, universal, worth-while game animal we have left?

Probably no one would calmly elect to do any of these selfish things. And, even if he would, he could not do it. It is impossible.

(b) The second answer is—protect the trees. Frank C. Pellett, of Atlantic, Iowa, writes to file a similar complaint against the Cottontail for tree girdling, but has the wisdom to acquaint us with a simple remedy. "Cottontails," he says, "are very abundant in this part of the State; and in winter, cause serious damage to young fruit trees.

"Several washes have been recommended by various fruit-growers to prevent injury, but they are of little value, except as a temporary expedient. I have found fresh blood to be more effective than any other wash. The best protection, however, is a wrapper of wire screen or tin placed around the body of the tree."[17]

Another method much used now out West and in Australia, is surrounding the orchard with a rabbit-proof fence of wire netting. This is quite effective.

(c) In my young days in the backwoods of Canada, we were much troubled by Rats gnawing harness. Evidently, Rats, like Porcupines, need

[17] The Cottontail, p. 291.

salt; what they got out of the harness were the sweat-salts from the Horses. It was simple to meet their need in another way. This we did by putting common table salt in various places around the stable, so that the Rats let the harness alone. This was striking a bargain, making a treaty with the Rats.

A similar solution for the Rabbit trouble is offered in the following: "Feeding Rabbits in winter to prevent attacks upon orchards," says Lantz, "has been successfully practised, on the theory that it is cheaper to feed than to fight them. One plan is to leave the winter prunings of apple trees scattered about the orchard. Another is to furnish corn, cabbage, or turnips in sufficient quantities to feed the Rabbits during cold weather. These methods have considerable merit, particularly the former, which seems to give excellent results when both Mice and Rabbits are present."[18]

With the same thought in mind, we may say that Cottontails are so fond of alfalfa and soy beans, that a crop of one of these is a guarantee of immunity to nearly everything else that grows in the garden.

Cottontail Cannibals

Of all creatures treated in this work, I should have thought the Cottontail furthest removed from the possibility of cannibalism, excepting, perhaps, the Horned Ruminants. So that the following by A. C. Thatcher, of Urbana, O., gave me an unpleasant shock: "Last winter, during the time of our big snow," he says, "a Cat caught a Rabbit close to my barn. I heard the Rabbit squalling, and drove the Cat away before she had killed her victim, but Bunny died that night. In the evening, it snowed again, covering all old tracks. The new snow, next morning, gave a clear account of what had occurred during the night. I found the partially eaten carcass of the Rabbit lying 20 feet from where it had died. Its flesh hung in long, fine shreds or strings—just such work as I should imagine a Rabbit would do with its long, sharp teeth; and not a track of anything but Rabbits was to be found. Neither Cat, owl, nor any other beast or bird had set foot in the snow near that place.

"I tracked 4 Rabbits from there, and jumped them all within 50 yards. I am as certain that carcass was eaten by Rabbits as if I had seen them eating it."[19]

Corroborative evidence is found in the fact that a similar habit is ascribed to the Snowshoe Rabbit. Also, those of us who have kept domestic Rabbits, know that such things occur in the "hutch"; though only when

[18] Farm & Orchard, p. 342.

[19] Recreation, Nov., 1902, p. 383.

the little ones are too small to look like Rabbits, and under circumstances which evidence some morbid condition. The records indicate that all animals (except the Horned Ruminants) will do the same thing when under similar stress.

Speed and Cunning

A Rabbit never runs or trots, in the way that Dogs or Deer do. She hops or bounds. In a fair race, straightaway across open, flat country, the Cottontail would stand no chance at all against a Dog, a Fox, a Coyote, or a Wolf. But Molly is not foolish enough to expose herself to any such unnecessary risk. Her first burst of speed may be as good as that of a Fox, for she has immensely powerful hind legs, and back muscles of unusual proportions. She can leap 10 or 15 feet at a bound, and cover two bounds in a second—for a time. *But she cannot keep it up.* Half a mile of such a pace, and she is at the end of her strength; especially if there be soft snow; and now, the fine art of misleading a trailing enemy is brought into play. Nothing else could be her salvation.

In my story of Molly Cottontail, I have set forth the many clever tricks that are used by Rabbits. These were not imaginary, though, of course, they were generic, not individual. I have seen each and all of them used many times by different Rabbits.

Kennicott, after large and varied experience, expressed the same ideas. "When pursued," he says, "an old male exhibits as much cunning as a Fox—doubling, turning aside, and permitting the Dog to pass, and then running on the back track; going through water, which it dislikes; and frequently, springing upon a log, and sitting motionless; while the Dog, in plain sight, beats around within a few feet of the spot.

"Usually, when one of these animals is started by Dogs, it runs a short distance; and, unless closely pursued, turns aside and stops. The Dog generally passes it, when it at once returns to the neighbourhood of its form; or, if unable to do so directly, an old one will frequently manage, by repeated doubling, to elude its pursuer, and reach its form again by a circuitous route. Should it be closely followed by a fleet Dog, it will make for a burrow, or a hollow tree, which has an opening at the ground into a cavity extending some distance above, up which it forces itself by bracing against the sides.

"Young Rabbits are not so apt to double and attempt to turn back to their forms, but often run immediately to a tree; and an old one will sometimes take to a hole without much doubling, especially if it has before been chased, and found refuge in the same retreat."[20]

[20] Quads. Ill., p. 79.

The straightaway, with nothing but speed, is, then, of little use to the Cottontail, as we have seen. The many tricks of doubling back and side leaping are effective. But even these are unravelled by a clever hound, and then the game is up, for Molly has little "bottom," while a bred hound can run all day.

But one more trick has Molly, that is, "hole up." The den of a Woodchuck or a Skunk is this final, safe retreat; and safe it is if the occupant be a sleepy Woodchuck, or if the Skunk be elsewhere.

Freezing

Every hunter knows that freezing is an established trick of woodcraft, among wild animals as well as among his own kind. When in the woods, a hunter becomes conscious of the nearness of another creature, his first duty to himself is "freeze"; that is, remain still as death till he has found out who the other creature is, and what is his intention. This freezing is absolutely essential to wood-life. Most animals are good at it; Deer are wonderful. But none of them can beat Molly Cottontail. In illustration of this, I give an incident from my journal:

Greenwich, Conn., June 18, 1914. At 7:40, as I went through the woods at dusk, a Cottontail hopped on to the path. He froze; so did I. I glanced at my watch, and timed him. For 2 minutes 35 seconds, he never budged nor winked, so far as I could see. Then he sank down on his hindquarters, and continued unmoving until 5 minutes was up. Now he seemed to shake a mosquito from one ear, but continued until 8 minutes 30 seconds had passed, when he again shook one ear. After a few seconds, he repeated the shake, and at 7:55 he hopped away. During all this time (15 minutes), I had stood, and moved but little, except to kill some mosquitoes.

Another note, made Jan. 18, 1905, implies that the Cottontail never winks, or else does it too quickly for observation. "To-day, I watched a near-by Cottontail for 2½ minutes, and it did not once wink. I have never seen a Cottontail wink, or close its eyes. When I struck a sharp blow on a near board, the creature seemed to droop the upper lid a fraction of an inch, but not more than one-tenth of the distance necessary to cover the eyeball."

Again: *June 13, 1906.* To-day, I watched a Cottontail that froze 6¼ minutes. Then I got tired. He did not even wink, so far as I could tell.

Swimming and Diving

The Swamp-rabbit and the Water-rabbit are, of course, much at home in the water; the Snowshoe and the Prairie-hare can swim when they must,

and frequently take to the water when they want to get to the other side. It is not surprising, therefore, to find Molly Cottontail swimming at times. The following instances show that she can do it very successfully, though it seems not to be her choice among modes of travel.

Norman A. Wood, of Ann Arbor, Mich., writes me:[21] "I once saw a Cottontail jump into a small stream, and swim across; and, so far as I could see, this was . . . voluntary."

Charles King of Frontenac, Minn., writes me: "In the summer of 1880, at Frontenac, Minn., I saw a Cottontail chased by boys, plunge into a little bay of Lake Pepin, and swim for a sandy point nearly 50 yards away. I never saw such a thing before, or thought it possible; for every Hare, chased by Coyote or hounds, that ever before came under my eye, would double on his tracks, or dart to right or left the instant water was sighted ahead; and this I have noticed along the Verde in Arizona, the Tongue and Yellowstone in Montana, and the Wind River in Wyoming."

The last and strongest incident was given me by J. H. Winscanley, of Kempton, Ind. When a boy, he saw a Cottontail swim the Ohio River at a point 5 miles above Willsville, where the river is half a mile wide. It was so exhausted that he easily caught it; but next day, he let it go. He did not see it enter the water; only coming out; but is satisfied that it came across from West Virginia.

Diving is close kin to swimming, even though it be into the snow. "Mount Tom," a writer in *Forest & Stream*,[22] says: "Not long ago, I saw a Rabbit play a trick on a Dog that I never saw done before. A Dog ran a Rabbit into the road, and it came near running under my Horses, but jumped back; and the Dog came near catching it, but it dove into the snow out of sight. The Dog grabbed into the snow where the Rabbit went, but did not get it. Then the Dog put its head into the snow above its eyes, and pushed along in the snow. The Rabbit came out of the snow three feet from the Dog, and went under a bridge. When it went out of sight, the Dog stood there wondering how it was done."

High-strung Nerves

In discussing the powers of the Cottontail, one is confronted by the extraordinarily high-strung nature of his nerves. Timid at all times is he, and extremely sensitive to sudden loud noise. The following incident is an example; in this, the bang of the gun apparently resulted in motor paralysis:

Four sportsmen from New Jersey, were shooting in Virginia, when

[21] Dec. 30, 1914.

[22] April 19, 1897, p. 284.

several Rabbits ran across the path. One of the men offered to bet he could catch the next Rabbit that crossed. The wager was no sooner made than out bounded a bunny. "John's chance had come. He leaped from the wagon, and entering the tall grass, went flying after the Rabbit. The shouts of the judges and referee were so boisterous that the Rabbit stopped to learn the cause of the commotion. So amazed was he at the wild antics of the onlookers, that he forgot his own safety until pounced upon by the sly John, and seized by the ears."[23]

The next incident is by Charles G. Blandford. He says: "Upon two occasions, I have known Rabbits to die of fright. While walking through the fields with a friend, armed with an old musket, he had shot at a hawk, and was reloading as we walked along. I had in my pocket a paper bag of shot. The powder was rammed home, and while fishing for the shot, to expedite matters, he fitted on the cap. At that moment, a Rabbit started out of a patch of high grass and briers in front of us. Jack raised the old musket; and not waiting for the shot, which I held in my hand, took a snap shot at about 20 yards, and the Rabbit rolled over. We thought, of course, the wadding had been aimed, balled, and struck the Rabbit in the back of the neck. That was not possible, for we found the pieces of newspaper which comprised the wadding lying about where we stood."[24]

The Ghost Rabbit and Strange Weaknesses

One night, in the August of 1888, I was out with my hound in the woods near Springfield-on-the-Credit, Ont. Uttering the familiar short yelps that meant "Rabbit," the Dog rushed into a brier patch; but at once, came back, shouting, "Help! help!" and took refuge at my feet. At the same moment, from the other side of the brier patch, went out a Rabbit all right —*but a snow-white one*. Now, Dogs are not supposed to be superstitious; but, on this occasion, Ranger acted precisely as though he had seen a ghost.

A similar incident is reported to me by Lionel Pearce, of Stonebridge, England. His terrier rushed on a cat-trail into a lobby, but came forth with yells of terror, when confronted by an undismayed and snow-white kitten.

Testimony to a strange weakness is found in the following instance; I cannot prove or disprove the statement. J. R. M. B. says:[25] "When a North Carolina darkie sees a Rabbit sitting in its form, he calls another one who, under the direction of the first, approaches the Rabbit from behind.

[23] S. P. L., Leesburg, Va., Recreation, Nov., 1898, p. 363.

[24] Forest & Stream, Feb. 18, 1899, p. 127.

[25] As above, Feb. 4, 1914, p. 207.

The Rabbit only notices the one in front of him; and he either stands still or moves very slowly, and not towards the Rabbit. The darkie approaching from behind, has no difficulty in seizing the Rabbit with his hands."

The Cottontail's Foes

A touching story in fable form comes back to me now from childhood days in the old log school-house. It told of the Hare so harmless "that every creature was her friend." Alas, for the cold light of research and its heartless revelations. Now I realize that the Wood-hare, our Molly Cottontail, is so harmless that every creature is her enemy. I do not know of a flesh-eating beast, bird, or reptile in the Cottontail's range, that does not look upon her as an easy, lawful, and desirable prey. One need not list them; all do it.

Even the Skunks take their yearly toll of the Cottontail, chiefly through destruction of the helpless broods when in the nest; though occasionally, the slow Skunk captures the swift Cottontail through the latter's making the mistake of hiding in a hole.

The Mink is well known to destroy many Rabbits, both by seizing them in the form, and chasing them into a burrow. Kennicott says: "I have repeatedly observed the track of the Common Mink for a great distance, as it wound about logs and brush-heaps, often entering hollow trees and burrows, sometimes following a Rabbit's track, till finally I have come to where an unhappy victim had been pulled down from a tree in which it had in vain sought refuge."[26]

In another case, he notes that several Rabbits made their headquarters under a barn, and were making sad havoc among the choice plants in the garden. But a Mink came by, and cleared them out for which he received the farmer's blessing.[27]

The following note, sent me by Wallace Evans, of St. Charles, Ill., April 26, 1913, seems to have been a case of "tamed by fear," just as a Panther and a Deer may continue together on a small island in flood time.

"While keeping a live Mink some time since in my specially constructed cage," says Evans, "I was unable to catch any live Rats to put in to him, but happened to have caught a live Rabbit that day, and put him in the cage instead. To my surprise, at the end of two days, both the Rabbit and Mink were huddled in opposite corners of the cage, neither one apparently taking any notice of the other. When I put live Rats into the cage, they are always very quickly killed by the Mink, but the Rabbit was absolutely untouched."

[26] Quads. Ill., p. 82.

[27] As above, p. 84.

Among the enemies that have the knack of making all the world hate them, are the Weasels. The Weasel is such an incarnate demon of brutal destruction that everyone sympathizes with the Cottontail, when the tracks of the two are seen in the snow, racing—the Cottontail to escape, the Weasel for the fell delight of taking life.

The Cottontail can escape hawks, owls, Foxes, Wildcats, Coyotes, Dogs, and men by taking to a hole in the ground. But, alas, for the day when it seeks in that way to escape from a Weasel. Any chance of safety that it had while afoot in the open, is now gone. The Weasel promptly seizes his victim. In vain, the Rabbit jambs its nose into a far corner to keep the blood-sucker from its head and neck. This only prolongs the agony, and whets the Weasel's appetite for the inevitable blood feast.

The final chapter in a race for life had an unexpected ending in a case reported to me by Prof. W. H. Sherzer, of Ypsilanti. It seems to show that the Cottontail is so terrified of the Weasel that, to escape him, she will face any other foe or take any other chance. "Last summer (1910)," the Professor writes, "my friend and fellow camper at Base Lake, Mich., was Prof. Frederick C. Hicks, of Cincinnati. He heard a most pathetic outcry, and rushed from his cottage to the front porch; and there saw an ordinary Cottontail Rabbit rushing up the narrow path, straight for the cottage, with a Weasel attached to its leg, and swinging back and forth as the Rabbit leaped. He was not in sight when the Rabbit started; but the Rabbit came straight for the cottage, and did not swerve when my friend reached the edge of the porch. The Weasel held on till about 4 feet distant from Hicks, when he let go, gave a vicious look at him, and scurried into the grass. The Rabbit continued his course, went under the porch just beneath where my friend was standing, and disappeared under the cottage; he had certainly gained his point, and saved his own life."

In spite of all these fierce, destructive foes, the Cottontail continues with us. Three reasons there are for this: first, her enormous fecundity—one pair may easily become 100 Cottontails during one year, if none are destroyed; next, her speed afoot; and last, the keenness of her senses.

Stories of the Trail

In the winter of 1901, I was at Goat Island, Niagara, and there saw a nearly complete record of a Mink pursuing a Cottontail through the snow. The two tracks, obviously made the night before, led under a great pile of logs and brushwood, and neither came out; so that there can be little doubt that, in the depths of that labyrinth, were lying the body of the Rabbit

PLATE CIV.—COTTONTAIL TRACKS AND YOUNG

partly devoured, and not far away, the Mink, well fed and curled up comfortably asleep.

Another tragic record of which the track evidence was complete, I observed at Toronto, Feb. 15, 1885. I give it in full, but have shortened the trail where it was uninteresting. (Plate CIV, p.798.)

At A, I found a round place about 5 inches by 8, where a Cottontail had crouched during the light snowfall. At B, he had leaped out, and sat looking around; the small prints in front were made by his fore feet, the two long ones by his hind feet; and farther back, is a little dimple made by the tail, showing that he was sitting on it.

Something alarmed him, causing him to dart out at full speed toward C and D. Now, a remarkable change is to be seen: the marks made by the front feet are behind the marks made by the hind feet, because the Rabbit overreaches each time; the hind feet track ahead of the front feet. The faster he goes, the farther ahead those hind feet get; and what would happen if he multiplied his speed by ten, I really cannot imagine. This overreach of the hind feet takes place in most bounding animals.

Now the Cottontail began a series of the most extraordinary leaps and dodgings (D, E, F,) as though trying to escape from some enemy. But what enemy? There were no tracks. I began to think the Rabbit was crazy—was flying from an imaginary foe—that, possibly, I was on the trail of a March Hare. But at G, I found for the first time, some spots of blood. This told me that the Rabbit was in real danger, but gave no clue to its source.

A few yards farther, at H, I found more blood. Twenty yards more at I, for the first time, on each side of the Rabbit trail, were the obvious marks of a pair of broad, strong wings. Oho! now I knew the mystery of the Cottontail running from a foe that left no track. He was pursued by an eagle, a hawk, or an owl. A few yards farther, and I found the remains (J) of the Cottontail, partly devoured. This put the eagle out of the question; an eagle would have carried the Rabbit off bodily. A hawk or an owl, then, was the assassin. I looked for something to decide which; and close by the remains, found the peculiar two-paired track of an owl. A hawk's track would have been as at K, while the owl nearly always sets its feet on the ground with two toes forward and two toes back.

But which owl? There were at least three in the valley that might be blamed. I looked for more proof, and got it on the near-by sapling—one small feather (L), downy, as are all owl feathers, and bearing three broad bars; telling me plainly that a barred owl had been there lately, and that, therefore, he was most certainly the slayer of the Cottontail.

As I busied myself making notes, what should come flying up the valley

but the owl himself—back to the very place of the crime, intent on completing his meal, no doubt. He alighted on a branch 10 feet above my head, and just over the Rabbit remains; and sat there muttering in his throat. I had neither gun nor camera; but he sat very still for a long time, and a sketch book was at hand, so I made a careful drawing.[28]

Insect Enemies and Others

Kennicott observes:[29] "Many Rabbits are infested by the larvæ of a large gadfly (*Œstrus*), and are hence said by hunters to have the 'wolf.' In their fur, live astonishing numbers of a peculiar flea, apparently differing from the common species."

Two cases of the warble or gadfly grub have I seen. One was in a male Cottontail that I got at Duluth, Dec. 3, 1908. It had an immense warble on its breast under the skin; and a second, a male, that I got near Tucson, Ariz., Jan. 22, 1923, had two huge living warbles side by side in its shoulder.

A new and unsuspected enemy is noted in the following from my journal: "On Nov. 7, 1920, I motored from Austin to San Antonio, Texas, some 82 miles. On the road, evidently killed by motors travelling at night, were 4 Cottontails, 2 Dogs, 2 Rats, 1 Possum, and 1 very large Skunk. It is remarkable that the Cottontail commonly suffers more than any other game animal from motor cars."

Disease, Sanitation, and Age

That the Cottontail is subject to the devastating plagues which periodically destroy the Snowshoe Rabbit, seems likely; yet no proof of it is at hand.

In Cal. F. & G.[30] is a long article by Prof. E. Ralph De Ong, of the University of California, detailing the parasites and diseases of Cottontails and Brush Rabbits. Among the insect and minute pests are wood-ticks, fleas, bot-flies, ear-mites, tape-worms, and sporozoa; with a list of consequent diseases or disablements. These seem to become rife as soon as the Rabbits are greatly multiplied in a given locality; but burn out as their hosts are reduced. It is as though nature had set an absolute embargo on great numbers without perfect sanitation.

In sanitary matters, the species has made little progress. Its home, being merely a nightly bivouac, is next morning found recklessly pebbled over with the scats of its recent evacuations.

[28] This appeared in Country Life in America, Dec., 1909, p. 246.

[29] Quads. Ill., p. 82.

[30] July, 1919, pp. 142–43.

A captive, which I kept for observation, dropped 125 pellets in one night; and urinated once, or perhaps twice. Another, a captive from Kansas, dropped 5,400 pellets in the two weeks ending April 20, 1926.

The Cottontail takes the periodic and tonic sunbath, but is not known to indulge in dust or water bathing.

Probably 6 or 7 years is the limit of age that is attained.

The Cottontail's Friends

The brier bush, the cactus thicket, and the thorn patch are the Cottontail's best natural friends. Where these abound, the Cottontails prosper; and where these are cleared up, the Cottontails pass away.

Man, destructive man, has, strange to say, lined up with the Cottontail's friends. First, he has made such a devastating war on Molly's enemies; second—and this is no small matter—his iron imitation of the thorn bush—that is, the barb-wire fence—has served marvellously to save and propagate the Cottontails in the far open prairie countries where once the species could not maintain itself. I look forward with confident expectation, to see the Cottontail in all the barb-wire country of the wheat-land that forms the Great Canadian Northwest.

Two other mighty and man-made protections the Cottontail now has: The sanctuaries that are being set up in many parts of the country; and the strong and growing sentiment which inspired the establishment of the sanctuaries—a sentiment which further manifests itself in organized efforts at implantations. For example, the editor of Forest & Stream[31] writes:

"Another implantation of 15,000 wild Rabbits from the West to repopulate New Jersey gunning ground, has been planned by the State Fish and Game Commission. . . . Results of the introduction of 10,000 Kansas Cottontails last year have delighted sportsmen, who report there is prospect of game increases in practically every county."

It is well to remember, however, that scientific naturalists disapprove of species from wholly different regions being introduced. They consider that the only truly biological plan is to preserve and foster the native species.

The Bunny Billions

Of all the animals that we to-day call "game," the Cottontail is the most numerous. Even in middle New York State, they abound; here Bachman tells of taking 12 in a morning.[32]

[31] Dec., 1924, p. 768.

[32] Q. N. A., I, p. 178.

The State Game Reports give a fairly accurate minimum of the number killed. Game Warden Bryan, of East Baton Rouge Parish, La., reports the following game killed during 1908 in his territory: Wildcats, 55; Rabbits, 10,000; Mink, 960; doves, 15,000; Squirrels, 5,000.[33]

Frank C. Pellett writes: "Three hunters killed 60 Cottontails in one favourable afternoon on 100 acres of land about my home [Atlantic, Iowa]; and continued the slaughter intermittently for weeks, getting as high as 30 in a day, on other occasions. Even then, there was no apparent diminu tion in the number of the little animals about. Although not always as abundant as the winter above mentioned, they are always very numerous; and the guns and Dogs do not seem to check them as effectively as the disappearing predaceous birds and mammals have done in the past."[34]

E. E. Pierson, of Bloomingdale, Ill., credits 2 local hunters with having killed and marketed 1,400 Rabbits in the 6 months ending April 30, 1912.[35]

Interesting information from North Carolina is furnished by Fred A. Olds, of Raleigh, N. C. The great dam on the Yadkin River, 88 miles from Raleigh, was complete and closed. The water began to rise rapidly behind it. Islands formed, and the Rabbits that were drowned out, gathered on these; on one of them a party killed 72 Rabbits in a quarter of an hour. Similar bags were made on other islands.[36]

North Carolina seems to be particularly suitable for Rabbits. H. H. Brimley writes:[37] "For the past two months, we have published each week the number of Rabbits shipped from Siler City [Chatham Co.]; and now that the season has closed, it may be interesting to note that a compilation of these figures shows that the total number shipped this winter amounts to 18,059. And it must be borne in mind that these figures apply only to Siler City, whereas there are three other shipping points in western Chatham.

"The number shipped this year is unusually large, considering that there was no snow. A comparison for the last 5 years shows the following:

1910	19,671
1911	16,573
1912 (the year of unusual snowfall)	26,060
1913	13,979
1914	18,059

[33] Forest & Stream, July 10, 1909, p. 56.

[34] The Cottontail, p. 291.

[35] Forest & Stream, May 11, 1912, p. 595.

[36] As above, Feb. 3, 1912, p. 142.

[37] As above, Feb. 28, 1914, p. 273.

"From the above, it is seen that the shipments are larger every other year. . . . And, in spite of the great number of Rabbits killed annually, the stock seems to keep up."

In New York State, 465,590 Cottontails were taken in 1918.[38]

The relative abundance of Squirrels and Cottontails is shown in the annual official report of game killed in Pennsylvania for 1921. It stood: Squirrels, 63,120; Cottontails, 440,446.

In Pennsylvania, according to the official count, 2,719,879 Rabbits, practically all Cottontails, were killed in 1919; and in 1924, thanks to good game laws, 4,160,000 were taken without seriously depleting the stock.

In Virginia, 293,625 Cottontails were killed during 1920 (T. S. Palmer, Game as a National Resource, 1922, Bull. 1049, U. S. Dept. Agri., p. 6).

Finally, by way of summary, fully 25,000,000 wild Rabbits—mostly Cottontails—are killed in the United States every year, according to estimates made by the U. S. Biological Survey.[39] The *Conservationist*[40] puts it much higher, maintaining that 200,000,000 wild Rabbits are killed each year in the United States.

Now, it is well known that many more are killed by hunters than are reported, for no report is made on those illegally killed—that is, out of season. And no account is taken of the millions that are devoured by natural enemies. The last is certainly the largest toll the Cottontails must suffer, for these enemies are legion, they are pursuing and murdering, night and day, old and young, the whole year round. So that, I am convinced that a legal killing of 25,000,000 represents an actual killing of 100,000,000 Cottontails per annum.

It is established that no wild animal can stand a heavier drain than 20 per cent. per annum of its total numbers. The Cottontail is increasing under present conditions; therefore, if these figures be right, there must be alive in the United States to-day not less than 500,000,000 Cottontail Rabbits; for which comforting thought I am devoutly thankful amid a dreary record of carnage and extermination.

Form and Burrow

Each individual has not only a home range, but a number of forms or sheltered beds which it uses in turn, varied by wind and weather, for the forms face different ways.

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[38] Bull. Am. Game Prot. Assn., Vol. VII, No. 4, pp. 11–14, Oct., 1918.

[39] As above.

[40] Nov., 1918, p. 176.

A form is nothing but a dry, well hidden nook with two ways from it—back and front. Usually it has a sort of roof, that is, enough to turn most of the rain. Those of us who want to be of help, have been putting sections of drain tile in the woods to give the Rabbits a ready-made ideal shelter.

Kennicott says that, in Illinois, the form "is in some concealed position, by the side of a log, in a small brush heap, or at the root of a bunch of briers and weeds, if in the woods; or it is frequently situated in the grass at the edge of the prairie, or of the sloughs that run into groves and outskirts of the woods; and here, as well as on the prairie, it is where the overhanging grass shelters and conceals it."[41]

The Cottontail will enter the deserted burrow of Woodchuck, Skunk, Fox, or Badger, under stress of danger or weather, but does not dig burrows for itself as does the English Rabbit.

Kennicott, the minute and careful, remarks, however: "I am credibly informed of a few instances in which they have been known to dig holes for themselves in hillsides; but these may be considered as departures from their natural habits."[42]

If we take advantage of snowtime, and are minutely observant, we shall find that each Cottontail has three or four forms or beds; and that these are joined by a few main trails which she ordinarily follows in going from one to the other. These trails are not very visible to us—we see them from too high a point—but to Molly, they are clear, open pathways, smooth, well labelled, and leading direct from one desirable place to another. One of them leads to some impregnable Cottontail castle, in case she has to baffle a Dog or Fox; and one always leads to the nearest garden. Molly always knows where she is going.

There is a well-worn path from the woods to my garden. I have seen her use it again and again. Indeed, I see her there each warm evening after sundown. But I have not stopped the path, or set a trap on it.

One day, I saw her enter by an open gate. I closed the gate and shouted. Molly ran straight for an opening in the wire fence at a point 3 feet up. She leaped for that, but failed to make it; so without a moment's hesitation or doubt, she steamed across to another point 200 feet away, and leaped up and through a hole in the wire at a place about 2 feet from the ground. A woven-wire fence has not many landmarks to hold the memory; but the precision with which Molly made for each of the two available holes, suggests that she had not only memory, but eyesight of the best description.

How small a hole a Rabbit can see or use is illustrated by the fact that

[41] Quads. Ill., p. 78

[42] As above.

Plate CV Details of Cottontail: A, newborn young; B, Cottontail with Moose bell; coll[n] of Jas. H. Fleming; C, yg. 10 days old. D. Abnormally grown teeth. Coll[n] Dr C. T. Runcies, Ind: E, right hind and fore paws; F, Cottontail tracks.

one of my Cottontails leaped with scarcely a pause through a mesh wire opening that was barely $3\frac{1}{2}$ by $2\frac{3}{8}$ inches.

Winter Dens

In cold winter, the Cottontail is seldom found in a form or bed, unless it be very well sheltered. She much prefers a hole under a stone pile, a hollow log or tree, at such times. She uses these for more than mere snoozing places, as we shall see. Indeed, she would not be true to rodent tradition if she did not at some time assume the deathlike torpor that may be called a "cold sleep." A driving storm sets in. Molly is ensconced under a thicket of briers and fern in one of her best forms, one most nearly weatherproof. The snow heaps up, shutting her into a sort of crystal-white cavern. Deeper and deeper piles the snow. Then the temperature falls, so that, though protected, she is numbed into a sort of frozen sleep. The raging of the storm outside kills every desire to venture forth. So long as the blizzard lasts, she rests, cold but not unhappy; a little hungry, perhaps, but not frozen—only drowsy—so drowsy that the easiest thing is to "lay low" and wait for better days.

Temper

Frank C. Pellett says:[43] "Although extremely timid, and offering no defence to an attack by other animals, they fight desperately among themselves, at least, in captivity. At present, we have a number of adults confined in wire pens, that were captured in box-traps. Now and then, an individual is very ugly with its fellows, and insists on tearing their fur and chewing their ears. A number have been killed in these scrimmages, and one with both ears chewed off still lives. A short time ago, we caught in a box-trap a specimen of the Nebraska Cottontail (*S. f. similis*), with holes in both ears. While this indicated a similar fight in the open, it is, of course, possible that these may have resulted from other causes than Rabbits' teeth."

Whether this berserker rage is peculiar to individuals or is an accompaniment of the mating season, I do not know. Kennicott formed a very different opinion of the Cottontail's combativeness. He says: "This Rabbit is not pugnacious, several even taking refuge in the same hole; but, though they exist in astonishing abundance in particular localities, they are not naturally gregarious."[44]

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[43] The Cottontail, p. 291.

[44] Quads. Ill., p. 78.

Tamability

It is a curious fact in the history of wild things that many of the wildest become most completely tame when properly managed; and many of those that, in their native state, are half-tame, can never be made domesticated or docile. Thus, the superferal Elephant, Wild Horse, Wild Dog, Wild-cat, Mink, Antelope, falcon, wild duck, respond completely when taken young, become members of the family. But the half-tame Fox, Hyena, pheasant, Canada jay, wood duck, and Cottontail, have never yet been tamed. They may be taken young and brought up so they tolerate our dwellings and our company, but never do they become truly members of the household—that is, domesticated—never do they learn to come at call, and rejoice in our company; never do they elect to stay with us when given the choice of returning to their wildwood kindred.

Good old Bachman, the father of loving natural history in America, wrote as far back as the '40's: "The Gray Rabbit, although it breeds freely in enclosed warrens, seldom becomes tame, and will probably never be domesticated. When captive, it seems to be constantly engaged in trying to find some means of escape, and though it digs no burrows in a state of nature, yet, when confined, it is capable of digging to the depth of a foot or more under a wall, in order to effect its object.

"We, however, at the house of Dr. De Benneville, at Milestown, near Philadelphia, saw 5 or 6 that were taken from the nest when very young, brought up by hand, so completely tamed that they came at the call, and leapt on to the lap of their feeder; they lived sociably and without restraint in the yard, among the Dogs and poultry. The former, although accustomed to chase the wild Rabbit, never molesting those which had, in this manner, grown up with them, and now made a part of the motley tenants of the poultry yard."[45]

Mating, Bearing, and Nest

There is little evidence on record regarding the mating habits of the Cottontail. What there is, direct and collateral, indicates that the species is very loose in such matters.

It is quite likely that a new mate for each mating time is the rule; and there are three or even four mating times each year.

On Jan. 22, 1923, near Tucson, Ariz., I found Cottontail males in early rut. On April 10th, at Victorville, Calif., I found male Cottontails in full rut; and a female with embryos as large as an acorn.

[45] Q. N. A., I, p. 176.

C. S. Brimley, of Raleigh, N. C., says: "Four very small embryos taken from a female March 11, 1901; 5 embryos from another on June 5, 1901. Four young (167–215 mm.) taken July 4, 1892, and 2 more two days later."[46]

Analogy indicates that gestation lasts about 30 days, but there is no definite direct evidence at hand.

The nest in which the young are nursed is a slight hollow, usually out in an open field or meadow, preferably on a borderland—never in dense woods, always where the sun strikes. I have seen it in long grass near the woods, in a bank by the road, in the grass alongside an avenue, out in an open field, and in a garden among the strawberry plants.

The scratching-out of the hole is done by the mother—the father has no part in it whatever; and it is usually about 5 inches deep, 7 inches long, and 5 inches wide. It is beautifully lined with grass roots, and a little of the mother's down, plucked bravely and painfully from her own breast with her own sharp teeth. Over the home nest, is always a wad of down and grass, a sort of dummy mother, which covers the little ones like a counterpane when mother is away, and hides them from enemies as well as keeps them warm.

The Cottontail's nest is far harder to find than that of most ground-birds. Its concealment is so nearly perfect that it is rarely found except by accident.

The Young and Their Care

The young are in number from 4 to 6 or 7, very rarely as many as 8, or as few as 3. In Carolina, Bachman says that they are born "as early as the 20th of February, and as late as the middle of October, and in all the intermediate months."[47] He goes on to say that there are three broods in a season.[48] Kennicott says "three or four times a year."[49]

When born, the young Cottontails are tiny squirming mites of pink flesh, little bigger than one's thumb. And, notwithstanding the statements of one or two ancient and honourable naturalists, they are born blind, helpless and nearly naked. In this, they contrast sharply with the Hares, which come into the world with eyes open, furry coats, legs and senses active, strongly developed.

A young one born of a Kansas specimen, Mar. 26, 1926, weighed 24 grams, that is, about $\frac{3}{4}$ oz. It measured $4\frac{1}{4}$ inches long, tail, $\frac{5}{16}$ inch, hind foot, $\frac{11}{16}$ inch. It was everywhere covered with very fine, short fuzz, but

[46] Journ. Mamm., Nov., 1923, p. 263.

[47] Q. N. A., I, p. 176.

[48] As above.

[49] Quads. Ill., p. 81.

had no hint of the adult colour pattern, except in having a white blaze on the forehead. A drawing of this specimen appears in Plate CV (p. 805).

Since the matter has been much discussed, I give the details of Cottontail nests that I observed:

Greenwich, Conn., May 8, 1920. Found 4 young Cottontails in nest near potato field. Took photo (May 10th) of nest and young Cottontail.

May, 12, 1921. Found a Cottontail's nest torn open. As no dead young lay about, it was probably the work of a Fox.

June 2. Found a Cottontail's nest on the drive, made, as usual, of dry grass lined with mother wool. It held 4 young, blind and helpless, but well-haired, maybe 10 days old. They kept jumping up vigorously when touched. I think they were hungry. This was before sundown.

June 4. After sundown, went to the Cottontail's nest. The mother sat near by, but soon ran away. I squeaked in vain; she would not come back, although two song-sparrows were much moved. The young were wholly covered up, and I think fully fed, as they lay very still when I touched them.

June 6. Went to the Cottontail's nest about an hour after sundown. The young were well covered and evidently well fed, for their little bellies were distended, and they were very logy. The eyes were not yet open of the one I took out, nor could I open them. I saw no sign of the mother near.

June 7. After sundown, I went to the nest. One young one had its eyes closed, one had them open. They were evidently hungry, but I saw no mother about.

Since European Rabbits' eyes are opened the 11th day, this would argue that they are about 10 days old, therefore born about May 27th.

June 8. 8 A. M. All the young Cottontails had their eyes open. At one hour before sunset, all were gone, a part of the nest lining lying 3 feet away. No Fox or Skunk would get them in the daytime. They might have been taken by a Dog, Cat, or crow; or possibly, they had simply scattered in their ordinary way.

On June 23, 1911, I found a Cottontail's nest in the grass at Cos Cob, Conn., on my grounds. It contained 4 young. I think they were less than a week old. Their eyes were closed, their ears were very short, but they had a coat of close, fine fur. Their growth the next three days was very rapid. On the third day, I went to the place, and saw a huge black Cat standing over it. The nest was empty. No doubt, the little Rabbits went the way of the canary. The mother must have visited them every night, for they were thriving. But she certainly did not once come in the daytime, as some of us were near by the whole time.

William's Bay, Lake Geneva, Wis., Friday, July 24, 1914. A Cottontail nest was found in the grass by the road just in front of my cottage yesterday. All the young (6) had their eyes closed. Sunday, all were open but 2. On July 20th, 4 only remained in the nest; all were big and strong. The mother came by night only. All were gone on Friday noon, July 31st. Therefore, they were in the nest 10 days or 2 weeks at most. (Plate CIV, p.798.)

J. D. Mitchell, of Victoria, Tex., after keeping and raising many broods of Cottontails in captivity, says: "When suckling her young, the mother Rabbit does not scratch away the weed and grass covering to the nest; but skilfully raises it and gets under it, curling herself around the outside of the nest, and cuddling her young to the centre, keeping the cover intact, and everything hid. I have had them remain quiet, and continue suckling their young when I lifted the straw covering to the nest."[50]

In Aug., 1910, at West Salem, Wis., the summer home of Hamlin Garland, I was shown a Cottontail nest in the garden among the strawberry plants. It was found by the children on Aug. 1st. It was a hole in the ground, 5 inches deep, 7 long, and 6 wide, beautifully lined with grass roots and a little of the mother's down. It contained 6 young, apparently nearly two weeks old, well-furred and active, but blind; one of them, a runt much smaller than the others, the family feebling.

That night, Garland watched until dark, but saw no sign of the mother. He laid some wet strawberry leaves on the coverlet; in the morning, these had been removed, showing that the mother had visited them in the night, completely covering them as before, but with other material.

All next day, they were watched by workers in the garden until dusk; and again we were sure that the mother did not visit them during the hours of light. Nor was she ever seen in the garden but twice—once in the early morning, and once after sundown.

On Aug. 5th, some of them had their eyes open; on the 6th, the rest also could see. When taken out of the nest at this time, they at once scrambled back again, and snuggled in, filling the hole completely. On the 7th, all had gone from the nest. One of them, found in the garden, was apparently able to take care of itself, though so small. When I lifted it, it squealed lustily, but the mother did not appear.

Up to that moment, none of them had uttered any sound, in spite of much handling by the children. On the only occasion when I saw the mother, I squeaked, but it did not seem to interest her; perhaps my squeak was poor.

The sum of testimony makes it certain that the mother visited them

[50] Nelson, Rabbits, pp. 14–15.

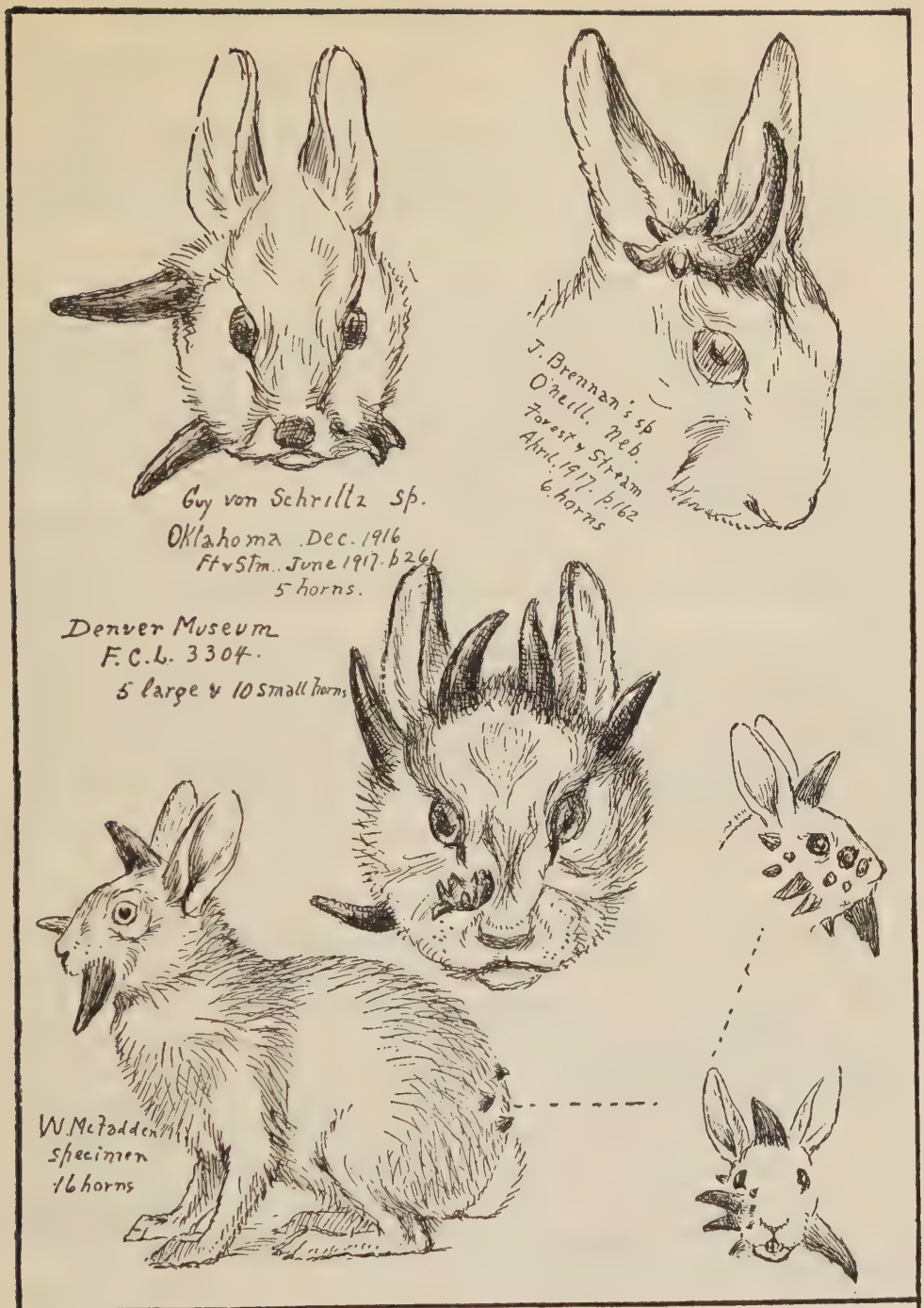

Plate CVI *Horned Cottontails* E.T. Seton

only at night; and the little ones seemed so lively that this is probably the normal habit of the species.

She may suckle them individually when she meets them during the few days following the dispersal; but there is no evidence to show that she ever gathers them together, or cares for them as a brood, after once they have left the nest.

After Leaving the Nest

The growth of the young Cottontails is very rapid, quite in line with their quick development in the nest. When barely two weeks old, and no bigger than a baby's fist, they may be seen running hither and thither through the woods, quite disbanded so far as nursery life is concerned. But there is evidence that they are still under mother's care. In a month, however, they are quite independent of her.

"I have caught the young ones in the grass," says Frank C. Pellett, "and have been surprised at the response of the mother to their cry. She came instantly, but her timidity overcame her anxiety, so that she ran away again."[51]

An interesting play-game between Squirrels and a Cottontail of this age, is reported to me by Miss E. A. Robinson, of Eaton's Neck, Northport, Long Island, N. Y. A brood of Gray-squirrels was raised in a tree at the end of their garden; and every evening between July 10th and 16th of 1923, the 4 young Gray-squirrels were met by a young Cottontail Rabbit that romped and played tag with them.

Brave Molly Cottontail

Molly, in a more stirring rôle, is thus portrayed by Kennicott. "It is pleasant," he says, "to observe that an animal usually so timid and unresisting, will fight bravely for its young. A naturalist tells me that he once saw a Gray Rabbit attack a large black snake, which was holding one of her young in its coils. She fought by springing over the snake, and striking back with her hind feet, which is the usual mode of defence of this species. Her blows were delivered with force and precision, and so rapidly that the snake was struck nearly every time; despite his attempts to evade them. As she passed, the snake aimed at her with his fangs; but, though he often scratched off a mouthful of hair, he was plainly getting the worst of the battle, when the naturalist interfered."[52]

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[51] The Cottontail, p. 291.

[52] Quads. Ill., p. 81.

Another instance is related in which a Rabbit was observed to pursue a hawk in the act of carrying off her young.[53]

The following incident, witnessed by three reputable citizens, is doubtless closely similar in its cause, etc. "During the last open season (August) for doves in this State," says H. Fields Saumenig, Rector of St. Peter's Church, Rome, Ga., "while driving in an automobile one afternoon toward a distant hunting ground, we were surprised to see a large black snake cross the road ahead of our car. The snake, fully 5 feet long, was travelling at a rapid rate, and was pursued by a Rabbit; the Rabbit all the while biting at the snake's tail, and attempting to put up a fight. When the snake disappeared in the brush on the other side of the road, the Rabbit gave up the pursuit, and recrossed the road, and was lost in the undergrowth.

"The only explanation that occurred to those of us who watched this strange performance, was that the snake had attacked the Rabbit's young, and the Rabbit was acting with the natural instinct of the mother in protecting her offspring. Two things are quite certain—the snake was plainly being beaten, and the Rabbit was putting up a fight."[54]

A like motive may have been back of the following incident, related to me by the famous archer, Will H. Thompson, of Seattle, Wash. About 50 years ago, his father, the Rev. Griggs H. Thompson, was travelling through a wooded part of Missouri, when he heard a loud "*qua-a-a qua-a-a qua-a-a*," like the cry of some little animal in pain. He peered through the bushes, and saw a Cottontail Rabbit leaping over the body of a Skunk, striking it with its hind feet, and uttering the squealing he had heard. The Skunk was dead, but evidently killed within a few minutes. Its skull was broken. It seemed impossible that the Rabbit should have done it, but there was nothing to show who else did, or why the Rabbit should be fighting the body.

A Private Letter

Greenwich, Conn.,
Jan. 23, 1927.

To Mrs. Molly Cottontail,
The Brier Patch,
Wild State, U. S. A.

Dear Molly:

I have just finished writing a long account of you for the children of America. I have tried to be very true and restrained, because I know that

[53] Quads. Ill., p. 81.

[54] Field & Stream, Dec., 1919, p. 798.

the children will show the chapter to their teachers, and it will come before the stern critics of the Biological Survey. But there is no use trying to hide from those men the fact that I am your friend.

Dear little Molly, I love you. And I wish I could, in honesty, exalt you to a high place in the world of intellect. Alas, I fear I cannot. You are but a sweet, dull-witted wild thing. You can scarcely be tamed, and cannot be taught at all. You have nothing but a Rabbit wit at best; and all attempts to domesticate and educate you, have scarcely robbed you of an insane and energetic desire to get away and hide.

"Harmless as a Rabbit" is an old adage; and, of all the soft, pretty things that roam our woods, you, Molly, most nearly live a blameless life. I would like to hold you above all reproach, but we cannot ignore the testimony of many naturalists—good friends of yours, like John Bachman, and his following. They maintain or admit, that you do at times destroy young orchards. Destroy orchards! Pah! I have looked fully into the charges, Molly, and find that sometimes a few orchard trees are peeled on your home range. Yes, it is so. But, in nine cases out of ten, it was done by Mice.

They hold that you cut off orchard twigs as high as you can—far beyond Mouse reach. Sometimes, no doubt, you do. But who wants orchard twigs growing so low as two feet from the ground? Pretty poor gardeners, I call any who do.

The truck farmers in Pennsylvania charge you with ruining their cabbage patches. The calamity-howlers! You took maybe one or two cabbages. Why don't they fence their cabbages, if they are so precious? Cows will eat cabbages; but is that a reason to go and shoot all the Cows?

They say that, if not you, at least your husband with your approval, has often broken out into a quarrelsome rage, and even murdered some neighbour whose ways were not to his liking. To this, I reply, first, it was not proven; and second, we are not discussing your husband.

They say that your intelligence never soared above tricks to save yourself or your children from hawk or hound. Well, what of it? To what better use could your wits be put? Show me a stronger guarantee of your right to live.

I have held against selfish men that, unlike most wildwood things, you care nothing for fruits or berries. You dig no holes to menace Horses' legs or water-dams. You have no evil habits that can be a curse to other dwellers on your range. Your orchard toll is trifling. You have never bitten nor scared a child; you have never even worried a Sheep. And certainly, you never robbed a bird's nest in all your life.

In short, dear Molly, every charge, trumped up or founded, has been

proven false or silly. We have defeated the enemy. The children are with me in proclaiming yours to be a blameless life. They shouted for joy when they heard how you made a fool of that big Dog that was trying to kill you. And, more than that, Molly, we all love you for your courage; the brave way in which you defended your baby from the black snake made for you millions of friends. It was noble—heroic. We are all for you—that is, we young folks.

You have won, and will ever hold a foremost place in our fields, our stories, and our affections—that is, as long as America has children to show the parents the better way. And if ever the time come that I cannot see you at sundown, near my house, I shall feel that the woods has lost one of the pleasantest things it has held for me, a daily joy I had learned to count on.

Your devoted admirer,

THE AUTHOR.

P. S. If I can do more, drop me a hint.

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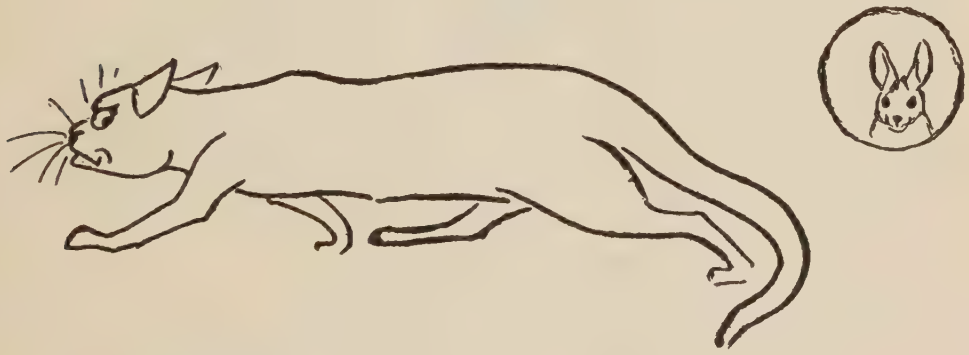

LIFE XCIX—BRUSH RABBIT

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RABBIT MULTIPLYING

Brush Rabbit of California, Bachman's Cottontail, Brush Bunny

Sylvilagus bachmani (Waterhouse)

(*Sylvilagus*, see *ante; bachmani*, in honour of the Rev. John Bachman, D. D.)

Lepus bachmani Waterhouse, 1838, Proc. Zool. Soc. London, VI, p. 103.
Sylvilagus bachmani Lyon, 1904, Smiths. Misc. Coll., XLV, p. 336, June 15.

Type Locality—California; on the coast south of Monterey, probably near San Luis Obispo

The Wasco Indians call it *Za-lak*.[1]

A ♀ specimen from Portola, Santa Cruz, Calif., taken March 24, 1895 (Am. Mus., No. 10718), is as follows:

Size. Total length, $13\frac{3}{8}$ in. (340 mm.); tail, $1\frac{1}{2}$ in. (38 mm.); hind foot, $3\frac{1}{8}$ in. (79 mm.); ear, $2\frac{1}{16}$ in. (52 mm.).

Colour. At first glimpse, it is, in colour, simply a huge Meadowmouse with a bob-tail and a yellow-brown nape. Compared with a typical Cottontail from Florida, it is much darker and less reddish; that is, it is olive in effect, very much peppered and with the Cottontail pattern traceable, but very dim; even the hip-patch is represented. Its underparts are dull grayish white, stained buffy at the edges—nowhere pure white; and much modified by the lead colour of the under-fur showing through, as in *Microtus*. The tail is short; above it is of the general back colour, thickly peppered; below, white or yellowish white.

It is, in brief, a small Cottontail with short legs, tail, and ears; and, in general, of an olive or brownish gray, nowhere pure white, except the underside of the tail.

Races

The following forms have been recognized:

bachmani Waterhouse, the typical form. T. l., California.

ubericolor Miller, a little larger than *bachmani;* ears smaller; upper parts darker and more reddish; skull, much heavier, with smaller bullæ. T. l., Beaverton, Washington Co., Ore.

[1] J. K. Lord, Naturalist in Br. Col., 1866, II, p. 102.

cinerascens Allen, much like *bachmani;* but upper parts, lighter, grayish brown; underparts, grayer; tips of feet, whiter; and ears, larger; skull, smaller and lighter, with larger bullæ. T. l., San Fernando, Los Angeles Co., Calif.

exiguus Nelson, similar in size and form to *cinerascens*, but with much longer ears and larger bullæ; upper parts paler, with ground colour more pinkish buffy; nape, feet, and legs, paler; and a fairly well-marked rump patch. T. l., Yubay, Lower Calif.

peninsularis Allen, most like typical *cinerascens*, including length of ears, but head and upper parts paler and grayer; ears, paler, and more brownish. T. l., Santa Anita, Lower Calif.

cerrosensis Allen, upper parts, nearly uniform grayish brown, like typical *cinerascens*, but slightly darker, and more buffy; with tops of fore and hind feet distinctly buffy. T. l., Cerros Id., Lower Calif.

mansuetus Nelson, size of *cinerascens;* palest of all the members of this group; colour, much paler and grayer even than *exiguus;* ears long, equalling those of *exiguus*. T. l., San José Id., Lower Calif.

History

Back in the first part of the last century, there was a famous traveller and naturalist named David Douglas. His chosen region for exploration was the Pacific coast of America; and many new species were the result of his travels: the Douglas Squirrel, Douglas Gopher, Douglas Groundsquirrel, and Douglas fir, for example. In the chaparral thickets of the Californian coast, he collected the first specimen of this species known to science. He sent it to the British Museum, where the skin remains to this day. G. R. Waterhouse, the *Rodentia* expert, recognized it as new; and, in 1838, named it after the Rev. John Bachman, the naturalist who supplies the text to Audubon's plates in the "Quadrupeds of North America."

Range

This Rabbit has the longest, narrowest ribbon of a range of all the creatures whose Lives are herein set forth. It stretches from the Columbia River to the red-tip of Lower California—some 1,800 miles—yet is less than 100 miles wide.

Habits

The Brush Rabbit seems different from the Cottontails of its region when viewed by the microscopically trained eye of the closet expert; but to the field-man and sportsman, their habits are much the same. Any differences that may be noted, arise from their choice of different haunts. In the dense thickets of low matted or thorny brush, they find the food and protection that they need. And there is little doubt that the remarks on the Cottontail's home life, signals, food, and enemies apply in a general way to those of its small brother, the Brush Rabbit.

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LIFE C—THE SWAMP-RABBIT

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Swamp-rabbit, Swamp-hare, Cane-cutter

Sylvilagus aquaticus (Bachman)

(*Sylvilagus*, see *ante;* L. *aquaticus*, aquatic, or, of the water)

Lepus aquaticus Bachman, 1837, Journ. Acad. Nat. Sci., Phila., VII, p. 319.
Sylvilagus aquaticus Nelson, 1909, *N. A. F.*, 29, p. 270, Aug. 31.

Type Locality—Western Alabama

This is the biggest of the Cottontail group.

In addition to the generic characters, the Swamp-rabbit has:

Size. Total length, 21 in. (534 mm.); tail, $2\frac{3}{4}$ in. (69 mm.); hind foot, $4\frac{1}{8}$ in. (106 mm.).

Weight. Bachman gives a female, 6 lbs.[1] Two males taken by myself near Austin, Tex., Nov. 6, 1920, weighed 4 lbs. 12 oz. each.

Colour. The Swamp-rabbit shows the basic Cottontail pattern; but dark, brownish, and much obscured. Its general colour is dark brown, coarsely peppered with black, almost splashed; all below, clear white, except on the chest which is pale brown. Legs, rump, upper tail, nape, and face, dull sienna brown; ears, without white.

Compared with *floridanus*, it is a bigger animal, darker, tinged all above with sienna, coarsely peppered with black. The grayness of *floridanus* is a strong feature; also *floridanus* has whitish hind feet, *aquaticus* brown.

Compared with *palustris*, it is bigger and not so dark, with all of its underparts white as in *floridanus*. Also, its tail is long, about 3 in.; whereas in *palustris*, it is about $1\frac{3}{8}$ in. In *aquaticus*, the under-side of the tail is pure white.

Comparison of the Three Species

	Cottontail (*floridanus*)	*Water-rabbit* (*palustris*)	*Swamp-rabbit* (*aquaticus*)
Total length	17 in.	17 in.	22 in.
Tail	2 in.	$1\frac{3}{8}$ in.	3 in.
Weight	3 lbs.	3 lbs.	6 lbs.

[1] Q. N. A., I, p. 288.

	Cottontail (*floridanus*)	*Water-rabbit* (*palustris*)	*Swamp-rabbit* (*aquaticus*)
General colour	gray	dark brown	yellow-brown
Under-side of tail	white	gray	white
Breast	white	gray	white
Hind feet	white	gray	brown

"Its feet are thinly covered with hair, and its toes (which are capable of being widely spread), are well adapted to enable it to swim, and to pass over marshy and muddy places."[2]

Races

The following forms have been recognized:

aquaticus Bachman, the typical form. T. l., Western Alabama.

littoralis Nelson, same size, but much darker and redder, especially on rump, hind legs, and tops of all the feet. T. l., Houma, Terrebonne Parish, La.

Range and Haunts

This is a species of the low, wet Mississippi Valley from the west side of Georgia to mid-Texas, and north to southern Illinois and Missouri, meeting but not overlapping the range of its cousin, the Water-rabbit.

Though called *aquaticus*, this species seems less aquatic than *palustris*. It is sometimes found in dry bottom-lands exactly like those places selected by the Common Cottontail, but usually lives in moist river bottom woodland or cane-brakes. In the oak groves near Austin, Tex., where first I met it, it was abundant, and lived much the life of a Jackrabbit. Bachman says:

"Although the Swamp-hare is occasionally seen on high grounds in the dense forest, it prefers low and marshy places, or the neighbourhood of streams and ponds of water, to which it is fond of resorting. It swims with great facility from one little islet to another."[3]

And Kennicott: "It lives constantly near water, in low and swampy grounds, feeding chiefly upon paludal plants; and it not only takes to the water and swims readily, but even dives without hesitation when pursued. In Southern Illinois and Missouri, it is observed to prefer the densest forest as well as the vicinity of water, being rarely seen on the hills or in open

[2] Q. N. A., I, p. 290.

[3] As above, pp. 288–89.

woods. It abounds in the deep cypress swamps and dark heavily timbered 'bottoms' along the Mississippi."[4]

Numbers, Tracks, and Food

We are told by several observers that this Rabbit is plentiful in the lower Mississippi Valley. What *plentiful* means, I do not know; but at Austin, Tex., where it is not plentiful, I saw a dozen in one morning's prowl. Almost the only definite information on its numbers is the following by Bachman:

"When the waters in the swamps are low, it seeks the first hollow tree, where it is easily secured. In this manner, Major [J. M.] Lee informed us, that in his vicinity the boys and the domestics caught 30 or 40 in 3 days."[5]

"The tracks of this species, and of the Marsh-hare, [*palustris*] in the mud, leave a distinct impression of the toes, whilst on the contrary, the tracks of the Gray Rabbit, the Northern Hare, and the Polar Hare, exhibit no such traces; their feet being so thickly clothed with long hair that even the points of the nails are scarcely perceptible."[6]

It "is generally found seeking its food in wet places, or near the water, as it subsists on the roots of various kinds of aquatic plants, especially on a species of iris growing in the water."[7]

Communication and Curious Habit

Probably all of the Cottontail group do their chief signalling by thumping with the hind feet; we have no observations to show that the Canecutter specializes in this department, but the following by Bachman is suggestive:

"Persons who have given us information on the subject of this Hare, inform us, that when first started, and whilst running, its trampings are louder, and can be heard at a greater distance, than those of any other Hare."[8]

In one habit, this Rabbit is said to be peculiar. It affects perches and high lookouts, much as do the Mountain Goats and sundry Squirrels. Thus,

[4] Quads. Ill., p. 86.
[5] Q. N. A., I, p. 289.
[6] As above, p. 290.
[7] As above, p. 289.
[8] As above, p. 289.

Kennicott says: "It generally rests upon logs, stones or other elevations, in preference to sitting in a form on the ground; a habit probably acquired from the necessity of choosing an elevated seat when inhabiting the swamps."[9]

Howell, on the other hand, considers this species like its cousins in its choice of form, and says: "I have started scores of the Rabbits, and *never* saw one anywhere but on the ground."[10]

Mating, Nest, and Young

Complete ignorance is the sum of our information on the mating of this Rabbit. But mating habits are usually alike in any given Family. This species is close kin of the Cottontail; and it has probably the same marriage customs.

Unlike the true Hares, it forms a nest. "The young of this Hare," says Bachman, "are frequently found in nests formed of leaves and grasses, placed on hillocks in the swamps, or in the hollow of some fallen tree."[11]

According to J. D. Mitchell, "the young of the Texas Swamp Rabbit (*Sylvilagus aquaticus*), are also born blind and naked."[12]

And the sage of Charleston rounds it out by adding: "We have been informed that it produces young at least twice in a season, and from 4 to 6 at a litter."[13]

His Way of Life

Dr. C. E. McDermott of LeRoy, O., contributes a colourful note on the way of the Swamp-rabbit.

"Three years ago," he says, "I spent 2 months in Alabama, on the Warrior River, and while there killed a few Rabbits of a kind new to me. The natives called them Water-rabbits. They are the colour of the common Gray-rabbit, and as large, or nearly so, as the Jackrabbit. All I found were sitting near the water, along the river. One sat in water, perhaps an inch deep, but with good cover about him.

"One day, while drifting with the current, watching for game ahead and along the banks, I saw something swimming in front of us. My partner said it was an Otter, and so I thought. As it passed out of sight around the bend, we put to shore and I got out and ran across and below where we saw it last. Coming cautiously to the bank, I saw the wake of something just

[9] Quads. Ill., p. 86.

[10] Personal letter.

[11] Q. N. A., I, p. 289.

[12] Nelson's Rabbits, p. 15.

[13] Q. N. A., I, p. 289.

below me, and still thinking it an Otter, I raised my gun and kept a sharp lookout.

"Soon I saw something move, in a bunch of floating weeds, and so did a passing hawk. The bird swooped, missed its quarry and, seeing me as it rose, sailed away. Then the animal in the water moved again and I fired.

"You can imagine my surprise on drawing from the water, a Rabbit as large as two of the common Cottontails."[14]

But such observers and recorders are few and scattered.

When gathering and shaping the meagre facts that show us his way of life, one is struck by his resemblance to a small Deer. His habitual feeding grounds are not in wet places, but rather in dry thickets near water. So the name *aquaticus* is unfortunate, for this animal is less of a water creature than his cousin, the *palustris*.

When the Cane-cutter is startled by the hunter, away he goes with high noisy bounds, displaying his white banneret, stamping on the hard ground with loud thumpings, to rise again, bounce away into friendly cover; and, if pursued by Dogs so swift, so tireless that he needs must hide, he again lives up to the Deer tradition by making for the water, where his scent may be lost, and himself escape by hiding.

Bachman was impressed with this resemblance, and wrote in the '40's: "As it suddenly leaps or bounds from its hiding place ere it is seen, it is apt to startle the rambler who has intruded upon its solitary retreat; and he may be impressed with the belief that he has started a young Deer. When chased by Dogs, the Swamp-hare runs with great swiftness, and is able to escape from them without difficulty; but it almost invariably directs its flight towards the nearest pond, as if led by instinct to seek an element in which all traces of its scent are soon lost to its eager pursuers. . . .

"Whilst the Gray Rabbit strenuously avoids water, the present species plunges fearlessly into it, and finds it a congenial element."[15]

"There is a specimen of the Swamp-hare, which we added to the collection of the Academy of Natural Sciences, Philadelphia, considerably larger than the Northern Hare; this individual, on being pursued by hounds, swam twice across the Alabama River, and was not captured till it had finally retreated to a hollow tree.

"We have been informed that it is a very common habit of this species when pursued, to swim to the edge of some stream or pond, retreat beneath the overhanging roots of the trees that may be growing on its border, or

[14] Recreation, July, 1898, p. 58.

[15] Q. N. A., I, pp. 289 and 291.

seek for a secure shelter under the hollows made by the washing of the banks. The swiftness of foot possessed by this Hare, and the stratagems to which it is capable of resorting, might easily enable it to elude pursuit, but for this habit of seeking for shelter as soon as it is chased, which is the cause of its being frequently captured."[16]

Especially is this so, when, as often happens, it makes the mistake of hiding in a hollow tree. Here it is safe indeed from Dog or Fox, but the hunter, alas! has many new wiles; a hole made with an axe or the brutal twisting-stick is quickly used, and the Cane-cutter is added to the list of dead.

References

1849—Quadrupeds of North America, by Audubon and Bachman, I, pp. 287–91.

1858—Quadrupeds of Illinois, by Robert Kennicott. Report of U. S. Comm. Patent, 1857, pp. 85–86.

1909—Rabbits of North America, by E. W. Nelson, *N. A. F.*, No. 29, pp. 14–15.

1921—Biological Survey of Alabama, by A. H. Howell, *N. A. F.*, 45, pp. 71–73.

[16] Q. N. A., I, p. 289.

LIFE CI—THE MARSH-RABBIT

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Marsh-rabbit, Water-rabbit, Pontoon-rabbit, Small Water-rabbit, Lesser Marsh-rabbit, Wet Rabbit, or Pontoon

Sylvilagus palustris (Bachman)

(*Sylvilagus*, see *ante;* L. *palustris*, of the marsh)

Lepus palustris Bachman, 1837, Journ. Acad. Nat. Sci., Phila., VII, p. 194.
Sylvilagus palustris Nelson, 1909, *N. A. F.*, 29, p. 266, Aug. 31.

Type Locality—Eastern South Carolina

When seen alive, the Water-rabbit looks much like a Cottontail, without any cotton under its tail; and of dark brown colour, much peppered on the back with black. Furthermore, its ears are very short and broad; its hind feet narrow, and short-haired.

In addition to the generic characters, it has:

Size. Total length, about 17¼ in. (438 mm.); tail, 1⅜ in. (35 mm.); hind foot, 3⅝ in. (92 mm.); ear, from the notch in the dried skin, 2 in. (51 mm.).

Weight. 2½ lbs.[1]

Colour. The Cottontail pattern is barely visible. Compared with typical *floridanus*, this animal is much darker, and more rusty coloured; coarsely peppered on the back with black. It has no pure white anywhere except, occasionally, inside the hind legs. Even the under-side of the tail is more or less gray.

From *aquaticus*, *palustris* may be distinguished by its smaller size, and shorter ears; by its redder colour, gray belly, and shorter tail.

Anatomy

"The feet of the Marsh-hare are admirably adapted to its aquatic habits. A thick covering of hair on its feet, like that on the soles of other species, would be inconvenient; they would not only be kept wet for a considerable length of time, but would retard the animal in swimming. Quadrupeds that frequent the water, such as the Beaver, Otter, Muskrat, Mink, etc., and aquatic birds, have nearly naked palms; and it is this peculiar structure,

[1] Q. N. A., I, p. 152.

together with the power of spreading out its feet, and thus increasing the space between each of its toes, that enables this quadruped to swim with great ease and rapidity."[2]

Races

The following forms have been recognized:

palustris Bachman, the typical form. T. l., eastern South Carolina.

paludicola Miller and Bangs, the smallest, darkest, and most reddish-brown of the Pontoon-rabbits; ears, very short, broad, and round. T. l., Fort Island, near Crystal River, Citrus Co., Fla.

History

Bachman writes: "As a remarkable instance of a species continuing to exist in a thickly settled country without having found its way into scientific works, we may refer to this very common species. We obtained specimens in Carolina in the spring of 1815. It was called by the inhabitants by the name of Swamp, and Marsh Hare, and generally supposed to be only a variety of the Gray-rabbit. We did not publish a description of the species until 1836. In the following year, Gray, who had not then seen the Transactions of the Academy of Natural Sciences of Philadelphia, in which our description was contained, described it under the name of *Lepus Douglassii*."[3]

Lepus douglassii Gray, is now, of course, relegated to the limbo of dead-weight synonymy, and Bachman's name stands. Moreover, this sad statement may be made without fear of contradiction: no one since Bachman, the father of animal-history in America, the Izaak Walton of our Quadrupeds, has written anything new of importance on this interesting creature's habits. Kennicott, the careful and minute, offers nothing but what is obviously taken from Bachman. Beyond some casual glimpses in Florida, I never met the creature myself; and this attempt at its life history is little more than a rearrangement of Bachman's 1849 account.

Range and Haunts

Its range is, as shown on Map XVIII (p. 684), the swamp-lands of the low region along the coast from the Dismal Swamp of Virginia south and west to Alabama, and including Florida.

The chosen haunts of the Marsh-rabbit are the low and, more or less,

[2] Q. N. A., I, pp. 153–54.

[3] As above, p. 156.

wet places that lie between the haunts of the Cottontail and those of the Muskrat.

"In high grounds, it is never seen," says Bachman,[4] and it "is generally found in low marshy grounds that are sometimes partially inundated, near rivers subject to freshets that occasionally overflow their banks, or near the large ponds called in Carolina 'reserves,' which are dammed up or otherwise made to retain the water intended to flood the rice-fields at the proper season.

"In these situations—to which few persons like to resort on account of the muddy nature of the ground, and the many thorny and entangling vines and other obstructions that abound near them; and which, besides, continually exhale from their stagnant waters a noxious vapour, which gradually generates disease—surrounded by frogs, water-snakes and alligators, this species resides throughout the year; rarely molested by man, and enabled by its aquatic habits, to make up for any want of speed when eluding the pursuit of its enemies.

"It winds with great facility through miry pools, and marshes overgrown with rank weeds and willow bushes; and is quite at its ease and at home in the most boggy and unsafe parts of the swamps.

"We have met with this animal a few miles from Columbia, South Carolina, 120 miles north of Charleston, along the muddy shores of the sluggish rivers and marshes; but on arriving at the high grounds beyond the middle country, where the marshes disappear, it is no longer to be found."[5]

Thus, to sum it up, we see that this *palustris* is the most aquatic of the Rabbits, far more so than the species misnamed *aquaticus*. For this lives by choice wholly in and about the water; the other seeks it only in emergencies —is, in fact, only a semi-occasional aquatic. The three may be arrayed as Cottontail, dry; Cane-cutter, damp; Pontoon, wet. It is most unfortunate that the damp one should be called *aquaticus*, and the wet one, *palustris*.

Numbers

Bachman, who followed it throughout its range, says: "It continues to increase in numbers as we proceed southwardly. It is abundant in the swamps of Georgia [and] Alabama."[6]

Referring to its distribution in Florida and Georgia, Bangs says: "The

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[4] Q. N. A., I, p. 156.

[5] As above, pp. 152–53.

[6] As above, p. 156.

Marsh-rabbit is most abundant in the salt marshes of the coast, where it occurs in great numbers, but is very common also in fresh-water swamps and marshes, and in hummocks."[7]

Finally, an approach to exact measurement is found in this remark by Bachman: "We have known 2 persons kill 20 in the course of a few hours."[8]

Food

The food of this wet-footed member of a bone-dry family is different from that of its kinsmen only by virtue of its different opportunities. As Bachman says:

"The Marsh-hare never, that we are aware of, visits gardens or cultivated fields, but confines itself throughout the year to the marshes. It is occasionally found in places overflowed by salt, or brackish, water, but seems to prefer fresh-water marshes, where its food can be most conveniently obtained. It feeds on various grasses, and gnaws off the twigs of the young sassafras, and of the pond-spice (*Laurus geniculata*). We have seen many places in the low grounds dug up, the footprints indicating that it was the work of this species in search of roots. It frequently is found digging for the bulbs of the wild potato (*Apios tuberosa*), as also for those of a small species of amaryllis (*Amaryllis atamasco*).

"We kept an individual of this species in confinement, which had been captured when full-grown. It became so gentle in a few days that it freely took its food from the hand. It was fed on turnips and cabbage-leaves, but preferred bread to any other food that was offered to it."[9]

Enemies and Diseases

There is no reason to suppose that the birds and beasts of prey recognize the fine distinctions that scientists proclaim between the various Rabbits. Therefore, Cottontail, Cane-cutter and Pontoon are similarly beset, so far as anyone knows.

Says Bachman: "This species, like all others of the genus existing in this country, as well as the Deer and Squirrels, is infested with a troublesome larva of an œstrus in the summer and autumn; which penetrating into the flesh and continually enlarging, causes pain to the animal and renders it lean."[10]

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[7] Land Mammals, p. 173.

[8] Q. N. A., I, p. 156.

[9] As above, p. 155.

[10] As above.

Flesh and Track

"This species possesses a strong marshy smell at all times, even when kept in confinement, and fed on the choicest food. Its flesh, however, although dark, is fully equal, if not superior, to that of the Gray-rabbit."[11]

"Its track when observed in moist or muddy situations differs very much from that of other species. Its toes are spread out, each leaving a distinct impression like those of the Rat."[12]

Mating and Nest

In general, no doubt, its mating customs and ceremonies resemble those of the Cottontail. But it differs considerably in its nesting.

Says Bachman: "The Marsh-hare deposits its young in a pretty large nest, frequently composed of a species of rush (*Juncus effusus*), growing in convenient situations. The rushes appear to be cut by it into pieces of about a foot in length. We have seen these nests nearly surrounded by, and almost floating on the water. They were generally arched by carefully bending the rushes or grasses over them, admitting the mother by a pretty large hole in the side. A considerable quantity of hair was found lining them, but whether plucked out by the parent, or the result of the natural shedding of their coat, (it being late in the spring, when these animals shed their hair,) we were unable to ascertain."[13]

Breeding and Young

The Marsh-hares "evidently breed several times in the season, but we have observed that the females usually produce their young at least a month later than the Gray-rabbit. Twenty-one specimens were obtained from the 9th to the 14th day of April; none of the females had produced young that season, although some of them would have done so in a very few days. On one occasion only, have we seen the young in March."[14]

"The young number from 5 to 7. . . . They bear a strong resemblance to the adult, and may almost at a glance be distinguished from those of the Gray-rabbit."[15]

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[11] Q. N. A., I, p. 155.

[12] As above, p. 154.

[13] As above, p. 155.

[14] As above, pp. 155–56.

[15] As above.

In the details of growth and development, they no doubt resemble their cousins, the Cottontails.

Habits

In some of its ways, this Rabbit is like the others of the genus. In its calls, its unsociability, its stamping, its non-resistance to a violent enemy, it resembles its cousins. But in one or two of its habits, it recalls sundry relatives who are more remote.

Thus it seems to have pathways like those of the Jackrabbit and Snowshoe. "In marshes," says Bangs, "it makes beaten runways along which it occasionally darts with astounding rapidity. It takes to the water readily and swims well, the ears and top of the head alone showing above water, with the fore feet splashing in front. Seeing one swimming thus for the first time, no one would think that it was a Rabbit."[16]

And Bachman, still our best authority after 70 years, writes: "In its movements, it is unlike most of our other Hares; it runs low on the ground, and cannot leap with the same ease, strength and agility they display. From the shortness of its legs and ears, and its general clumsy appearance as we see it splashing through the mud and mire, or plunging into creeks or ponds, it somewhat reminds us of an overgrown Norway Rat endeavouring to escape from its pursuers.

"The Marsh-hare is so slow of foot, that but for the protection afforded it by the miry tangled and thorny character of its usual haunts, it would soon be overtaken and caught by any Dog of moderate speed. We have observed the Negroes of a plantation on a holiday, killing a good many of them by first setting fire to the half-dried grasses and weeds in a marshy piece of ground during a continued drought, when the earth had absorbed nearly all the moisture from it, and then surrounding the place, with sticks in their hands, and waiting until the flames drove the Hares from their retreats, when they were knocked down and secured as they attempted to pass.

"Several Gray-rabbits ran out of this place, but the men did not attempt to stop them, knowing their superior speed, but every Marsh-hare that appeared, was headed, and with a loud whoop set upon on all sides and soon captured."[17]

"Some of the habits of this Hare, differ greatly from those of others of the genus; it seeks the water, not only in order the easier to escape from its pursuers, but when in sportive mood; and a stranger in Carolina, should he

[16] Land Mamm., p. 173.

[17] Q. N. A., I, p. 153.

accidentally see one amusing itself by swimming about, if unacquainted with the habits of the animal, would be puzzled by its manœuvres.

"When the Marsh-hare is startled by the approach of danger, instead of directing its flight toward high grounds like the Gray-rabbit, it hastens to the thickest part of the marsh, or plunges into some stream, mill-pond, or 'reserve,' and very often stops and conceals itself where the water is many feet deep, among the leaves of lilies or other aquatic plants."[18]

Fire may drive it out of its sheltering thicket, but water has no terrors for it. Bachman continues: "After a heavy rain had produced a flood, which inundated some swamps and ricefields near us, we sallied forth to see what had become of the Marsh-hares, and on beating the bushes, we started many of them, which ran from their hiding places, plunged into the water, and swam off with such rapidity that some escaped from an active Newfoundland Dog that we had with us. Several of them, supposing they were unobserved, hid themselves in the water, about 15 yards from the shore, protruding only their eyes and the point of their nose above the surface; when thus almost entirely under the muddy water, with their ears pressed back and flat against their neck, they could scarcely be discovered. On touching them with a stick, they seemed unwilling to move until they perceived that they were observed, when they swam off with great celerity.

"A few evenings afterwards, when the waters had subsided and returned to their ordinary channels, we saw a good many of these Hares swimming in places where the water was 7 or 8 feet deep, meeting, or pursuing each other, as if in sport, and evidently enjoying themselves."[19]

When the Cottontail is confronted by a water hazard on its line of travel, it goes around or makes a mighty effort to leap over; but the Marsh-hare, like the Indian in the North woods, welcomes a chance to travel the water-route. It may not be a quicker way, but is, at least, a safer way.

"We have on a few occasions seen this Hare take to a hollow tree when hard pressed by Dogs, but (as we have just remarked) it usually depends more for its safety on reaching marshy places, ponds, or impenetrable thickets."[20]

Bathing

In line with its propensities for water, is the bathing habit that Bachman noted in one Wet-rabbit which he held captive.

"In warm weather," he says, "it was fond of lying for hours in a trough

[18] Q. N. A., I, p. 154.

[19] As above.

[20] As above.

of water, and seemed restless and uneasy when it was removed; scratching at the sides of its cage, until the trough was replaced when it immediately plunged in, burying the greater part of its body in the water."[21]

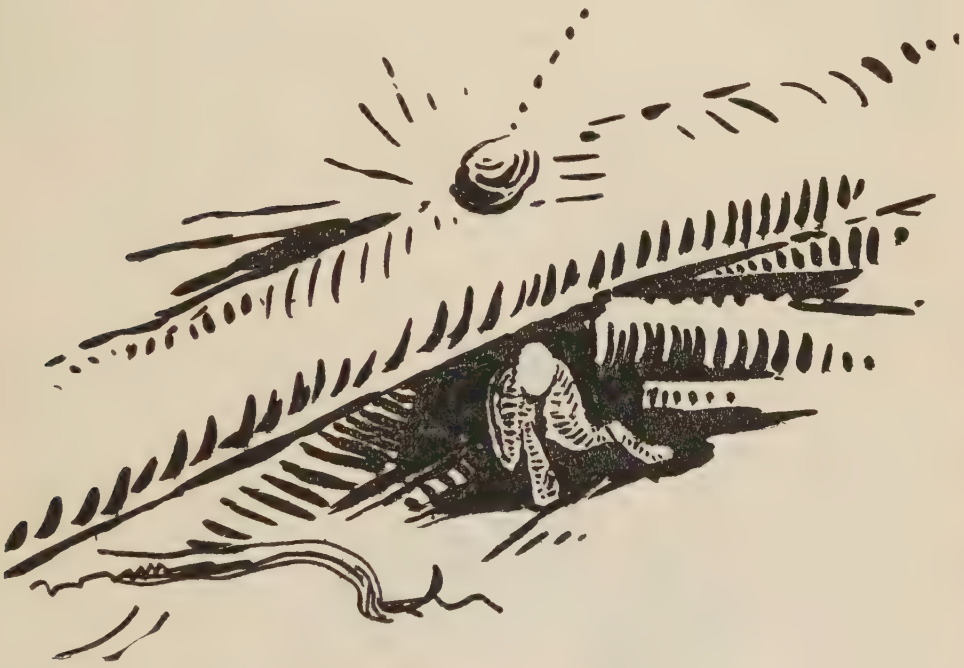
References

1849—Quadrupeds of North America, by Audubon and Bachman, I, pp. 152–56.

1898—Land Mammals of Florida and Georgia, by Outram Bangs, March, p. 173.

1921—Biological Survey of Alabama, by A. H. Howell, *N. A. F.*, 45, pp. 73–74; 1 map.

[21] Q. N. A., I, p. 155.



LIFE CII—PYGMY RABBIT

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The Pygmy Rabbit of Idaho, Short Rabbit, Burrowing Rabbit

Brachylagus idahoensis (Merriam)

(Greek *brachus*, short, on account of its all-round shortness; *Lagos*, Hare; L. *idahoensis*, of Idaho.)

Lepus idahoensis Merriam, 1891, *N. A. F.* 5, p. 76, July 30.
Brachylagus idahoensis Miller, 1900, Proc. Biol. Soc. Wash., XIII, p. 157, June 13.

Type Locality—Pahsimeroi Valley, Idaho

This is the only known member of the genus, *Brachylagus*; in fact, said genus was erected by Miller (1900) in order to accommodate this anomalous and elusive creature. While *Brachylagus* resembles *Sylvilagus* (which is mongrel Latin-Greek for the "Wood-hare" i.e., Cottontail) in general make-up, it is distinguished externally, by being much smaller and by a general shortness—head, ears, limbs, and tail all share in the process of abbreviation. Its Squirrel-like skull also is blessed with numerous peculiarities, many of them in the line of shortness.

In life, the creature looks like a cross between a Rat and a Rabbit. It is not unlike a Coney—a resemblance enhanced by the absence of tail.

To the generic characters, it adds the following:

Size. Total length, about 10 in. (254 mm.); tail, about $\frac{3}{4}$ in. (19 mm.); hind foot, $2\frac{3}{4}$ in. (70 mm.); ear from notch, $1\frac{5}{8}$ in. (41 mm.). A Cottontail's ear is about $2\frac{3}{4}$ in., and a Jackrabbit's over 5 in., which helps us to realize the shortness of this Pygmy's ears.

Colour. The coat, in spring and summer, may be represented by a male specimen from Minidoka, Ida. It was taken July 25, 1910, by S. G. Jewett; and is as follows:

All above, warm gray, softly peppered with blackish brown, darker on the back and crown. The legs, nape, and ears behind are tinged with warm sienna; the ears inside, the chin and lower parts are dull whitish; there is no pure white anywhere. The upper side of tail, like the back; under-side a little grayer; but the tail—what little there is of it—is practically of one colour throughout, both upper and under-sides, quite unlike that of most Rabbits, and contrasting sharply with that of its nearest cousins, the Cottontails. This is a strong feature.

In less degree important, is the fact that its ears have a conspicuous lining of long gray hairs; probably a result of its underground life, for without some such protection, the loose falling sand might be troublesome.

In winter, it looks like a dull whitish Rabbit. A Feb. 10th specimen from Rupert, Ida., is much paler and grayer all over, except on nape and legs, where the sienna is exaggerated by contrast. Its foot-bristles are enlarged, and it looks as though trying to turn into a Snowshoe, with about 50 per cent. of success.

Range

Map XVI (p. 607) shows the range in outline; but to its broad information, we must add these details: The Pygmy Rabbit is a creature of the dry desert country, where vegetation is very scarce, and running water practically unknown. Wisely, therefore, this child of the sand does contentedly without all the things it cannot get; and it would as soon think of taking a drink of water, as it would of climbing a tree.

Haunts

"This Rabbit seemed to be quite generally distributed throughout the district [Malheur Co., Ore.], where it is recognized by ranchers," says Anthony, "as being distinct from the Cottontail. It has a decided preference for little draws and flats where the sagebrush grows thickly, and where rabbit-brush (*Chrysothamnus*) occurs in extensive patches. In fact, the best way to hunt this animal was to look for the bright yellow of *Chrysothamnus*, and then work that vicinity. Very rarely could one be found at any distance from rabbit-brush. This may have been only a coincidence, for spots where the rabbit-brush grows are generally more luxuriant in vegetation than adjacent localities; but it remains a fact that a dozen Rabbits were seen in places as described above, to every one that could be found out on the sparsely brushed flats and hills. It was mere accident if one *idahoensis* was found where the low sage grew, and conditions suited the other species of the *Leporidæ;* but one might be reasonably sure of seeing several in any extensive growth of rabbit-brush and tall sage. Here they appeared to colonize, and as many as 8 or 10 were seen in a forenoon, on several occasions. On account of the thick growth, and the animal's habit of circling about under cover, an accurate count of the inhabitants of such a locality was difficult to obtain."[1]

[1] Mamm. Malheur, p. 22.

Habits

This is the only Rabbit in our limits that habitually digs and lives in burrows underground; it is a Hare with the habits of a Mouse. It is the smallest of its group; so small that it could not fit into the stalls provided by existing genera, so they had to make a little one for it all by itself. Having said this much, we have given nearly all that is known of this unique and beautiful little by-product of the sagebrush plains.

Its Rat-like size, pale colours, short ears, and apparent absence of tail, make this smallest of our Rabbits easy to know, if you are in the sagebrush during twilight hours; and it will elude you by darting mouselike down some hole, thereby showing that it is no baby Jackrabbit, nor even a young Cottontail. But it avoids observation, and it further abbreviates one's chances of familiarity, by coming out solely after sundown.

Dr. Merriam, who originally discovered and described it, spent two months collecting on its range in 1890, and writes: "That but half a dozen specimens of this little Rabbit were secured during more than two months spent in the very centre of its abundance, seemed very strange to us, until we learned, near the close of the trip, two important facts concerning its habits; namely, that it is almost exclusively nocturnal, and that it makes its home in deserted holes of the Badger (*Taxidea americana*). The only individual I succeeded in shooting, was killed at the mouth of a Badger hole just at daylight; and the specimens trapped, were caught at the mouths of old Badger holes which had been partly filled with earth. Had we learned these facts earlier, we could easily have captured many more. Two or three others were caught, but were eaten in the traps by Coyotes.

"This Rabbit has very short legs; and, in running, keeps close to the ground, not leaping, as most Rabbits do. It was never found away from the plains and valleys covered with sage (*Artemisia tridentata*) and *Tetradymia canescens*."[2]

H. E. Anthony, who studied the Pygmy in Oregon, says that it "did not seem to be as wild as the *Sylvilagus nuttalli* often found in the same spot. *Idahoensis* would start from under a bush, and, in a series of leisurely hops or short runs, if not too greatly alarmed, melt away into the thick cover. Careful following on the trail would discover a ball of brownish fur at the foot of some clump, with eyes watching the back trail, and nervous ears on the alert. Cautious movements would permit approach to within ten or twelve feet. In fact, one great drawback in securing specimens, was this close proximity of the animals. In the thick growth they affect, the hunter

[2] Mamm. Ida., pp. 75–76.

PLATE CVII.—PYGMY RABBIT OF IDAHO

From photograph by Harold E. Anthony

does not see one until it has started from under his very feet, where it is manifestly impossible to shoot it; and, before it has reached a distance where it would not be uselessly mangled, the animal has interposed brush between itself and the danger. Pursuit only brings a repetition of this, or finds the Rabbit motionless at ridiculously close range."[3]

Social Instinct

"The social instinct might, at first glance, appear to be rather more developed in *Brachylagus* than in other *Leporidæ* of the region, because of this habit of preference for restricted areas; and observations seem to bear this out. Not infrequently, two of the animals were put out from the same clump of brush; and it was generally noted that the residents of each particular area would be found more or less congregated at one part of their chosen district. This was not due to conditions of food supply, evidently, for the next visit might discover them at the opposite end. When one Rabbit was seen, more often than not, others would scurry out too, before any great distance was traversed."[4] "At no time was *B. idahoensis* heard to utter a sound."[5]

Running Habits

"Doctor Merriam in his remarks on the species when he described it, mentioned the fact that *idahoensis* runs differently from the other Rabbits. This point was well borne out by my observations. The Pygmy runs more in a scurrying manner, like a Ground-squirrel, keeping close to the ground, and rarely leaping as *Sylvilagus* is wont to do. When moving at their leisure, these animals would progress in short hops; but when speed was their desire, they scuttled low to earth."[6]

Den

Unlike the rest of the group, this small creature of the undertangles has its home very definitely beneath the surface.

However, it does not emulate the European Rabbit by excavating long, complex tunnels for its own use—an underground labyrinth—but uses such ready-made burrows as it can find without an owner.

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[3] Mamm. Malheur, p. 22.

[4] As above.

[5] As above, p. 24.

[6] As above, p. 23.

Young

Doubtless, its young are born in some far corner of its tunnel; but no one so far has seen and recorded the nesting habit. Probably the young are 4 to 6 in number, but no one knows.

Anthony says: "Young Cottontails and Black-tail Rabbits were often seen in the same thick cover with *Brachylagus;* but so distinctive was the Pygmy that, if one good glimpse was obtained, no doubt as to identity could exist. *B. idahoensis* appears, in life, to be quite bluish-gray or rufous brown, accordingly as the animal has changed its pelage; and its apparent lack of a tail sets it apart from the young *S. nuttalli* with his twinkling tuft of cotton.

"Young of *idahoensis* were seen fairly often, and nearly full-grown specimens were secured. Most of these noted, ranged from two-thirds grown to the mature of the year. One was seen, however, about the size of a man's fist, Aug. 21st; but was lost in thick brush before it could be secured."[7]

Diurnal and Nocturnal

The statement made by Dr. Merriam, says Anthony, "that *idahoensis* is almost exclusively nocturnal, was not substantiated, as far as I could note; nor did I get the impression that this Rabbit was in the habit of using Badger holes for their homes to an extent that would make them difficult to find in the day time. I could be as reasonably certain of seeing *Brachylagus* in the day time as I could be of finding *Sylvilagus;* and the same feeding habits and hours seem to apply to the one as to the other.

"As an instance of their being abroad in the daytime, feeding, several were shot in fairly open spots where the nature of the surroundings made their dwelling in old Badger holes a necessity; and each time the animal was seen at the entrance to the burrow, but far enough outside to show that he had just run up to the burrow from his feeding quarters, on the approach of danger. Where their favourite conditions prevail, none were seen at burrows; and I think that here, the thick brush affords ample protection, and the surface form answers all the requirements for a home, at least during the summer. In such a spot, Rabbits, when seen, were always started from under the brush, and rarely did I drive one to a burrow, as the animal would double and turn, and seek to hide in the brush, a proceeding he would not be apt to resort to if he had a burrow near by in which he was accustomed to seek refuge. But, when he lacked the cover to hide in, as did a few which

[7] Mamm. Malheur, pp. 23–24.

were seen in more open localities, his one idea was to escape down the first old Badger hole he could find—precisely what one would expect *Sylvilagus* to do under the same circumstances. Once or twice, the Rabbits of a *Chrysothamus* patch, three or four in number, were found at the very outskirts of the cover, and made for the deeper brush when I alarmed them. This was in the later forenoon, and it would appear that the animals were feeding, and had not yet retired to the denser cover for the midday."[8]

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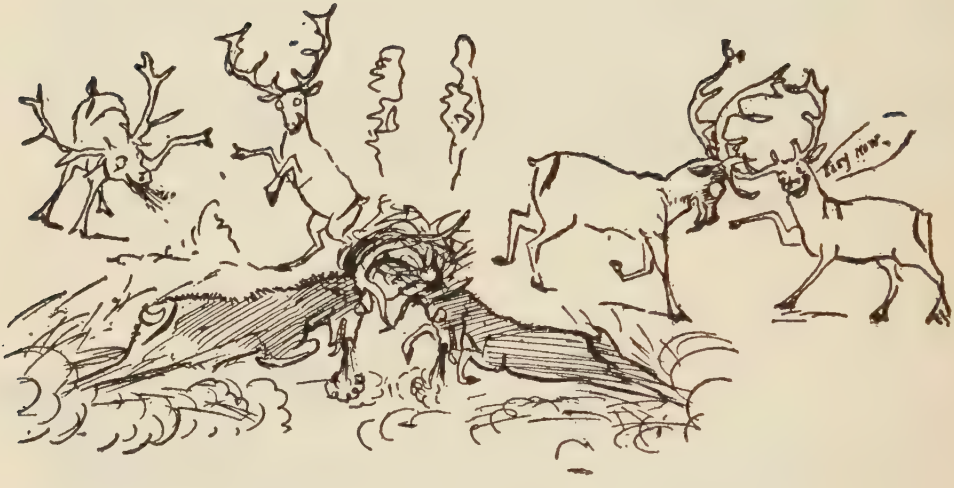
1891—Mammals of Idaho, by C. Hart Merriam, *N. A. F.*, 5, pp. 75–76.

1909—Rabbits of North America, by E. W. Nelson, *N. A. F.*, 29, pp. 275–78; 1 map.

1913—Mammals of Malheur Co., Oregon, by Harold E. Anthony, Am. Mus. Nat. Hist., Vol. XXXII, pp. 22–24.

[8] Mamm. Malheur, p. 23.



LIFE CIII—ARMADILLO

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Nine-banded Armadillo, Common Armadillo, or Peba

Dasypus novemcinctus Linnæus

(Gr. *dasus*, thick or rough; *pous*, foot; L. *novem*, nine; *cinctus*, banded)

Dasypus novemcinctus Linnæus, 1758, Syst. Nat., ed. 10, Vol. I, p. 50.

Type Locality of the form first described, is in South America, probably Brazil; but the type of the Texan and only United States form is from Brownsville near the mouth of the Rio Grande

The Family *Dasypodidæ* includes the Armadillos. They have the body covered with a bony carapace, with 7 to 9 movable ring-joints around the middle; a long pointed snout; long ears; long tail, with scaly rings; front feet with 4 toes, hind with 5, all with strong, slightly curved claws.

As to dentition, the Armadillos go further than some others of their Order, and have dispensed with both canines and incisors, but still retain rows of simple, peg-like molars.

Teeth:

$$\text{Inc. } \frac{0-0}{0-0}\text{; can. } \frac{0-0}{0-0}\text{; mol. } \frac{8-8}{8-8} \text{ or } \frac{7-7}{7-7} = 32 \text{ or } 28$$

They have one pair of inguinal mammæ, and one pair of pectoral.

When seen alive, Armadillo is very suggestive of a small, active and very smooth Pig, or a cross between a Snapper and a Razorback.

In addition to the characters of its group, a typical Rockport, Tex., specimen of nine-banded Armadillo has:

Size. Total length, $28\frac{1}{2}$ in. (723 mm.); on the dry skin of which tail is 13 in. (330 mm.); hind foot, $3\frac{1}{4}$ in. (82 mm.).

Weight. 12 to 15 lbs.

Colour. In the museum skin, it has no colour that is pigmentally describable; simply a purple-brown horn-tint darker on the back, much lighter on the tail and sides; varied, however, with dark blotches. But a

recent specimen before me, is beautifully variegated with spots and triangles of delicate flesh colour on a background of very dark gray, nearly black. On the tail, feet, snout, and edges of the shell, the flesh tint deepens into a delicate rose colour.

In regions of black soil, this creature is commonly darker than in sandy places. The difference is probably due to mechanical staining of the shell.

Armour

The Armadillo is everywhere covered with beautiful, sculptured and regular horny plates, even on the ears where they are very small and delicate. On the inner side of the legs and on the belly, where not needed, rigid economy has reduced the plates to little or nothing, using instead the cheaper material of bristles, a few of which are scattered on the back between the bony plates and bands. The body armour is broken by 9 rings or banded joints, which are broad on the sides, and narrow on the back, where, indeed they are reduced to 8.

The tail has 14 rings—horny joints that look as though they would telescope into each other—and a final 4 or 5 inches of scaly tip, like the tail of a snake sticking out of the last joint.

The sharp, strong claws or hooflets, when well worn, remind one of the claws of a turkey that has had to scratch gravel all summer.

The long, thin, extensile tongue is covered with a stuff as sticky as fly-paper. This the creature shoots out, and lashes about among insect swarms; and so feeds riotously on what most animals would consider not proper food.

So much for the dry details of this little armoured car. But one must have had a long training in mediæval harness-equipment to appreciate the exquisite hand-made workmanship on this extraordinary little brute. Its armour is of harmonious make throughout, of the hardest available material; yet no two portions of it are quite the same. Each part has a style suited to its own brunt or need of souplesse. The whole is a combination of case armour, chain mail, and metal bosses on leather—Roman, Saracen, and Middle English, whichever best suits the need—and softly graded into each other. It looks as though handmade by a smith of consummate skill, an armourer and an artist. For it is full of beautiful lines and patterns; it is light, and it works so perfectly that there is never a squeak or a rattle, never a loose joint or a missing part, no gap for the weapon of a foe to enter.

It is so effectual, indeed, that the Armadillo is enlarging its range.

Races

The typical form is *novemcinctus* Linnæus, from Brazil. Besides this, three races have been described from the North American continent, and one from the West Indies, as follows:

mexicanus Peters, with frontal region of skull, high and inflated. T. l., Colima, Mex.

texanus Bailey, like *mexicanus*, but with heavier dentition, and larger plates on forehead and wrists. T. l., Brownsville, Tex.

fenestratus Peters, intermediate between *novemcinctus* and *mexicanus*. T. l., Costa Rica.

hoplitis G. M. Allen, similar to *novemcinctus*, but smaller; skull smaller, with tooth-row decidedly shorter. T. l., Lesser Antilles.

History

The earliest notice I find of this quaint little beast is in Samuel Purchas' "Pilgrimages," 1617, Book III, p. 909, "Of the Beasts, Fowles and Plants in America: The Armadillo is an admirable creature, of which there be diuers kinds: they resemble a barded [armoured] Horse, seeming to be armed all ouer, and that as if it were rather by artificiall plates, opening and shutting, then naturall scales: it digges vp the earth as Conyes and Moules."

Range

The Armadillos are an American product. They are not found in any part of the Old World, although their African cousins, the Manis and Pangolin, have many features in common with them, including their membership in the Edentata. Their centre of abundance is the warm parts of South America from Argentina northward. The Nine-banded is spread from Argentina to Texas; and is, of course, split into many races, corresponding with the numerous environments in which it is found. Vertically, it ranges from sea level to about 10,000 feet of elevation.

Expressed in good, set, biological terms, the Armadillos in Texas are creatures of the "strictly Lower Sonoran, but in the rough country between Rock Springs and Kerrville, they range fairly into the edge of Upper Sonoran Zone. As a rule, they do not extend east of the semi-arid or mesquite region, nor to any extent, into the extremely arid region west of the Pecos, but occupy approximately the semi-arid Lower Sonoran region of Texas, north to near latitude 33°."[1]

[1] Bailey, Texas, p. 54.

Its Northward March

The Armadillo is a successful species. It has solved its immediate problems, and hence, is adding to its range, instead of receding before the encroachments of settlement. This means, of course, that the settlers are harder on the creature's enemies than on itself, so that an ever-growing balance is struck in the Armadillo's favour. How such rare statements do give the naturalist a thrill of joy!

According to H. P. Attwater: ' When in Port Levaca last week, I obtained some notes in regard to Armadillos, which may be of interest. Mr. J. M. Boquet, a very intelligent and reliable ranchman, says that these animals were first noticed in Calhoun County in 1886 or about that year; that they are now very common, and that he has no doubt there are hundreds of them in the county to-day. He says their favourite resort on the prairie ranches is in the long Cherokee-rose hedges, which have been grown in many parts of that and adjoining counties as a wind-break in winter for Cattle. During the last few years, since Armadillos have become so common in the Southwest and south-central Texas, I see baskets made of Armadillo skins or shells in the curio stores at San Antonio and other places."[2]

In the *Journal of Mammalogy* for Aug., 1926 (pp. 206–10), John K. Strecker gives full details of the Armadillo's recent and triumphant march eastward and northward from the mouth of the Rio Grande. He says in summary: "Until about the early '70's of the last century, the Lower Rio Grande Valley was the principal home of the Armadillos in Texas."[3]

He continues: "In order for the Armadillo to extend its range, it was first necessary for it to cross the Rio Grande at low water. The high mountainous region west of the Pecos River seems to have formed somewhat of a barrier, so the trend of migration was northeastward rather than northward. In the '70's, the animals had already worked their way across the Nueces; and a short time later, were in the San Antonio River Valley. In 1890, they had reached the Colorado, and by 1895, they probably had penetrated to the Brazos Valley. At the present time, they are found in the drainage areas of the Trinity and Neches rivers; and from the above indicated data, have at Hemphill almost crossed the Sabine; and a little higher up, have already crossed that stream into the alluvial bottoms between the Sabine and Red rivers. . . . In eastern Texas, it seems to be occupying the territory formerly inhabited by the Peccary and the Ocelot."[4]

[2] Bailey, Texas, p. 54.

[3] Extension, p. 207.

[4] As above, p. 210.

After mentioning some Negro reports that in northwestern Louisiana, there was a "dry lan' varmint, wid er turpin (terrapin) shell," Strecker adds: "Last summer, however, I found my friend, Mr. L. S. Frierson, Jr., of Gayle, La., in possession of the tail of a specimen which had been killed 2 miles north of Westdale, Red River Parish."[5]

There seems to be no climatic or ecological reason why this interesting and harmless animal should not spread over all of the Southern States south of latitude 32°.

Numbers

Where found at all, the Armadillo is commonly in large numbers. Bachman says: "We have heard that in some parts of Nicaragua, the Armdillos are so common that they can be purchased for a medio—six and a quarter cent piece"[6] which may prove either the abundance of Armadillos or the scarcity of cash, according to the further light.

A more exact, as well as picturesque, illustration is given by Bailey: "In Autumn," he says, "during the Deer-hunting months, when the young of the year are full-grown, they [the Armadillos] are especially numerous; and particularly obnoxious to the still-hunters who repeatedly mistake their rustling in the leaves for the noise of feet of bigger game. Where a dozen or 20 Armadillos are met in a day's hunting, as sometimes happens, and possibly no Deer are seen, the nervous strain and disappointment on the part of the hunter sometimes result in serious consequences to the innocent Armadillo."[7] To which he adds: "Almost every rock-walled gulch along the headwaters of Guadaloupe River has one or more dens"[8] of this interesting little armoured Pig.

Haunts

Capt. J. P. McCown who lived in Texas during the early '40's, told Audubon that at that time, "the Armadillo is to be found in the chaparrals on the Rio Grande. I have seen their shells or coat-of-mail on the prairies; whether carried there by larger animals, or birds, or whether they inhabit the prairies, I cannot say."[9]

"This Armadillo lives by preference amid the cover afforded by the forests, brushy jungle, tall grass, or other vegetation. In the midst of such

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[5] Extension, p. 207.

[6] Q. N. A., III, p. 225.

[7] Texas, p. 56.

[8] As above, p. 55.

[9] Q. N. A., III, p. 224.

shelter, it usually digs its own burrow a few yards deep in a bank or hill slope, beneath a stump, under the roots of a tree, or a rock, or even on level ground."[10] But it commonly occupies small natural caves in hillside or among rocks.

Bailey says: "They are partial to low, dense cover of coarse grass, thorny thickets, cactus patches, and scrub oaks, under which they make numerous burrows and trails, or root about in the leaves and mould, where they enjoy comparative safety under the double protection of leafy screen and armour plate. But they thrive best in a rocky country, especially where limestone ledges offer numerous caves and crevices of various sizes, from which they can select strongholds that will admit no larger animal."[11]

To which Strecker adds: "Its ability to suit itself to various physical conditions, is one of the most remarkable things in connection with its range extension. It seems to be equally at home in alluvial creek bottoms, the edges of swamp tracts, rock-walled gulches, limestone hills, chaparral prairie, and sandy islands."[12]

Nocturnal Tastes, and Senses

The Armadillo is commonly listed as a strictly nocturnal animal. We have already encountered reasons to warn us against making any animal ever strictly anything. And, of course, the Armadillo also comes forward with some flagrant breaches of the "strictly nocturnal" law. For many observers have seen the creature up and doing merrily in the very glare of noonday. It is worthy of note that all animals which burrow underground, and spend much time in the gloom of dark caves, find it necessary to come out occasionally for the tensifying tonic of a strong sunbath.

It seems to be a rule, for reasons more or less obvious, that no underground animal sees well. The armour-bearer's eyesight is so poor, says Nelson, that one "may approach openly within about 30 yards before being noticed."[13]

Burrows

The Armadillo is highly specialized in many ways; one might say in most ways—anatomy, exterior, and habits. One of its unusual gifts is its power as an excavator, for it has the body of a Badger, and the claws of a gigantic Mole. Whenever it has nothing better to do, it digs a hole. It digs

[10] Nelson, W. A. N. A., p. 585.

[11] Texas, pp. 54–55.

[12] Extension, p. 210.

[13] W. A. N. A., p. 585.

for food, it digs for a bed, it digs for escape, it digs for a home, it digs for a nursery, and it digs for fun. It spends much of its time underground, mining like a Mole. Roosevelt relates that "twice, while laying railway tracks near São Paulo [Brazil], Kermit had accidentally dug up Armadillos with a steam shovel."[14]

One naturalist, Audubon, says that these holes "are generally dug at an angle of 45°, are winding, and from 6 to 8 feet long."[15] Then he adds: "Their holes are often dug in the sides of steep banks or hills, and in thick and dense parts of the woods."[16]

"But," he continues, "when the Armadillo has a chance of escape by digging into ground, it is no sluggard in its movements, and progresses towards the depths of the soil with surprising rapidity."[17]

Animals which dig, have usually three or four different types of burrow: —the food burrow,—a mere prospect shaft sometimes developed into a profitable mine; the home den; and the playground. We know little about the Armadillo's activities in any of these.

Mating, Den, and Young

What the mating customs are, is utterly unknown. Nothing but the fact that the creature does make a home den is on record.[18]

In North America, this side of the Rio Grande where we have definite winter and summer, the young are born from February to April.

Vernon Bailey tells me that the Armadillo invariably has 4 young, never more.[19]

"They have their eyes open at birth," says Nelson, "and the armour is soft and flexible like fine leather. The hardening of the skin into a bony armour is progressive, continuing until after the animal fully completes its growth. As soon as the young are able to travel, they trot along with the old one, during her foraging trips."[20]

"Early one afternoon," continues this naturalist, "when riding along a trail in the heavy forest of southern Oaxaca, accompanied by an Indian boy and a pack of Dogs, I suddenly came upon an old Armadillo and 8 young [evidently two families, V. B.] about two-thirds grown. They had heard our

[14] Braz. Wild., p. 88.

[15] Q. N. A., III, p. 224.

[16] As above, p. 225.

[17] As above, p. 223.

[18] See Azara.

[19] Personal letter, March 3, 1927.

[20] W. A. N. A., p. 585.

approach, and stood motionless in a compact little group, half hidden in the grass. I had barely time to stop my Horse, when the Dogs spied them and made a rush. The Armadillos darted into the undergrowth in every direction like a litter of Pigs, and with the exception of two caught by the Dogs, gained safe refuge in their burrow. This we found dug in the level ground about 50 yards from where we encountered them."[21]

Food of the Toothless

Every highly specialized animal is, first of all, specialized for peculiar food.

"The principal food of this genus," says Audubon, "consists of ants of various species, which are so abundant in some portions of Central and South America as to be great pests to the inhabitants of those parts of the world."

This species, he continues, "we were informed by Captain Charles H. Baldwin, [is] kept in Nicaragua, not only by the people of the ranchos, but by the inhabitants of some of the little towns, to free their houses from ants, which, as is said, it can follow by the smell. When searching for ants about a house, the animal puts out the tongue, and scrapes the ants into the mouth from around the posts on which the houses are raised a little above the ground, and has been known to dig down under the floors, and remain absent for 3 or 4 weeks at a time. . . . They are said to dig down in a straight direction when they discover a subterranean colony of ants, without beginning at the mouth or entrance to the ant-hole. There are two favourite species of ant with the Armadillo in Nicaragua, one of which makes nests in the forks of trees in the forests. The tree ants [termites] are white, the others small and black. The Armadillos keep about the roots of the trees in order to feed upon the former, and as we have already said, dig for the latter.

"They also root up the ground with their Pig-like snout, and do some damage to gardens. They are very persevering when in pursuit of ants, and whilst they turn up the light soil with the snout, keep the tongue busy taking in the insects.

"It has been assured us that when a line of ants (which may sometimes extend some distance in the woods) are busily engaged in carrying provision to the general storehouse, they scatter in every direction at the instant the Armadillo begins to dig down towards their stronghold, evidently having some communication from headquarters equivalent to '*sauve qui peut.*'"[22]

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[21] W. A. N. A., p. 585.

[22] Q. N. A., III, pp. 223–24.

To this he adds that "Armadillos are said to eat young birds, eggs, snakes, lizards, etc."[23]

Nelson ascribes to it a still wider range of diet. "The food of the Armadillo," he says, "consists almost entirely of many species of insects, among which ants appear to predominate. When searching for food, the animals become so intent that they may be cautiously approached and closely observed, or captured by hand. They root about among fallen leaves and other loose vegetation and soft earth, now and then digging up some hidden grub or beetle. At night they visit newly ploughed fields in their haunts, rooting in the mellow earth. They are accused of digging up plants in gardens during their nocturnal wanderings, and in Texas have been charged with robbing hens' nests of eggs, and of reducing the supply of wild turkeys and quail by breaking up the nests, all of which needs confirmation. Their method of feeding appears to vary considerably, as they have been seen rising on their hind legs to secure small caterpillars infesting large weeds.

"The insect food eaten by the Nine-banded Armadillo Texas, as known from examination of stomach contents, covers a wide range of insect and other small life, including many species of grasshoppers, crickets, roaches, caterpillars, beetles, ants, spiders, centipedes, and earthworms. As the list includes also wire-worms and other noxious species, these inoffensive animals deserve thorough protection as a most useful aid to the farmer."[24]

Excrement

So singular a gastronomic history is properly capped by a remarkable output of "scats." See Plate CXIII (p. 891). Bailey says: "The excrement of the Armadillos found scattered along the trails in the form of clay marbles, and with the texture of baked mud, gives some clue to the food habits of the animals. Careful examination shows only the remains of insects, mainly ants and a few small beetles, embedded in a heavy matrix of earthy matter."[25] Deer make their marbles of wood fibre.

Speed

The first time I saw a living Armadillo, I got a great surprise. Its tortoise-like appearance prepared me for a creature tortoise-slow. Yes, and some books of good repute had led me to expect a slow-moving, logy thing ready to shut up like a clam at the least sign of danger. But this creature was

[23] Q. N. A., III, p. 223.

[24] W. A. N. A., p. 585.

[25] Texas, p. 56.

trotting briskly about like a caged Fox, even galloping at times; and when I succeeded in getting my hand on its back, it gave me a strange thrill to find it warm, almost hot.

One of the best pictures of the Armadillo at home and "carrying on" is from the pen of Roosevelt. It shows the real Armadillos as he saw them in Brazil—a larger species than ours, but of similar habits.

"Early one morning," he says, "we came across two Armadillos—the big Nine-banded Armadillo. We were riding with the pack through a dry, sandy pasture country, dotted with clumps of palms, round the trunks of which grew a dense jungle of thorns and Spanish bayonets. The Armadillos were feeding in an open space between two of these jungle clumps, which were about 100 yards apart. One was on all fours; the other was in a squatting position, with its fore legs off the ground. Their long ears were very prominent.

"The Dogs raced at them. I had always supposed that Armadillos merely shuffled along, and curled up for protection when menaced; and I was almost as surprised as if I had seen a turtle gallop when these two Armadillos bounded off at a run, going as fast as Rabbits. One headed back for the nearest patch of jungle, which it reached. The other ran at full speed—and ran really fast, too—until it nearly reached the other patch, 100 yards distant, the Dogs in full cry immediately behind it. Then it suddenly changed its mind, wheeled in its tracks, and came back like a bullet right through the pack. Dog after Dog tried to seize it or stop it, and turned to pursue it; but its wedge-shaped snout and armoured body, joined to the speed at which it was galloping, enabled it to drive straight ahead through its pursuers, not one of which could halt it or grasp it; and it reached in safety its thorny haven of refuge.

"It had run at speed about 150 yards. I was much impressed by this unexpected exhibition; evidently this species of Armadillo only curls up as a last resort; and ordinarily trusts to its speed, and to the protection its build and its armour give it while running, in order to reach its burrow or other place of safety."[26]

Enemies and Their Bafflement

The Armadillo would not be the good fellow he is, if his world did not abound in hostile possibilities that he is just able to outwit. There is nothing like a few enemies for making a triumphant good fellow.

Concerning his internal troubles and ailments, we know nothing. But it is safe to say that every big flesh-eating bird and beast is ready to devour

[26] Braz. Wild., pp. 87–88.

the mail-clad one, provided they can catch and master him. Just what and which these enemies are, is not fully recorded; but it must surely take a creature of mighty jaws or talons to penetrate the panoply of this, the original armoured car.

Nelson says: "I have found the remains of many Armadillos where they had been killed and eaten by Coyotes or other predatory beasts."[27] More than this I do not find. I cannot even learn that, like most creatures of the tropics, he has a continuous desperate fight with insect parasites.

The Armadillo has three answers for a foe big enough to be dangerous. The first and simplest is to run away; and how effectively he does that, has already been set forth in the section on Speed. The second is to "dig himself in." This he does with promptness and energy when, to his way of thinking, it is the one wise answer to the problem—though he and you may have formed different conclusions on the situation. The third is to curl up in a ball—to demonstrate his complete parallelism to the Box Turtle.

Audubon writes: "This animal, however, on being much alarmed, rolls itself up, and does not attempt to fly; and it is chiefly when it has been digging, and is at or near the mouth of a hole, that it tries to escape; preferring, generally, to be kicked, tumbled about with a stick, or be bitten at by a Dog, to making an effort to run."[28]

When alarmed, the Armadillo immediately runs to shelter. In Mexico, Nelson considers it slow enough to be overtaken by a man, and "may easily be caught in one's hands, especially if intercepted on the way to its den. When caught, it will struggle to escape; and while it may coil up in a ball in the presence of a Dog or other mammal foe, I never saw one try to protect itself in this way."[29]

A final touch given as hearsay by Audubon, and to be read with reserve, is this statement: "We have heard it asserted that when it has the advantage of being on a hill or elevated spot, the Armadillo, upon the approach of danger, forms a ball-shaped mass of its body, with the tail doubled under the belly, starts down the hill, and rolls to the bottom."[30]

In the way of a fighting self-defence, be it noted, the Armadillo can lash out vigorously with its hoof-like claws, front and hind; for it has great strength of limb, and can inflict quite a wound if it hit fair and square on an unprotected part. Even if lifted by the tail, it often succeeds in reaching the incautious hand with a sharp-toed kick. It can bump hard against a small

[27] W. A. N. A., p. 585.
[28] Q. N. A., III, p. 223.
[29] W. A. N. A., p. 585.
[30] Q. N. A., III, p. 223.

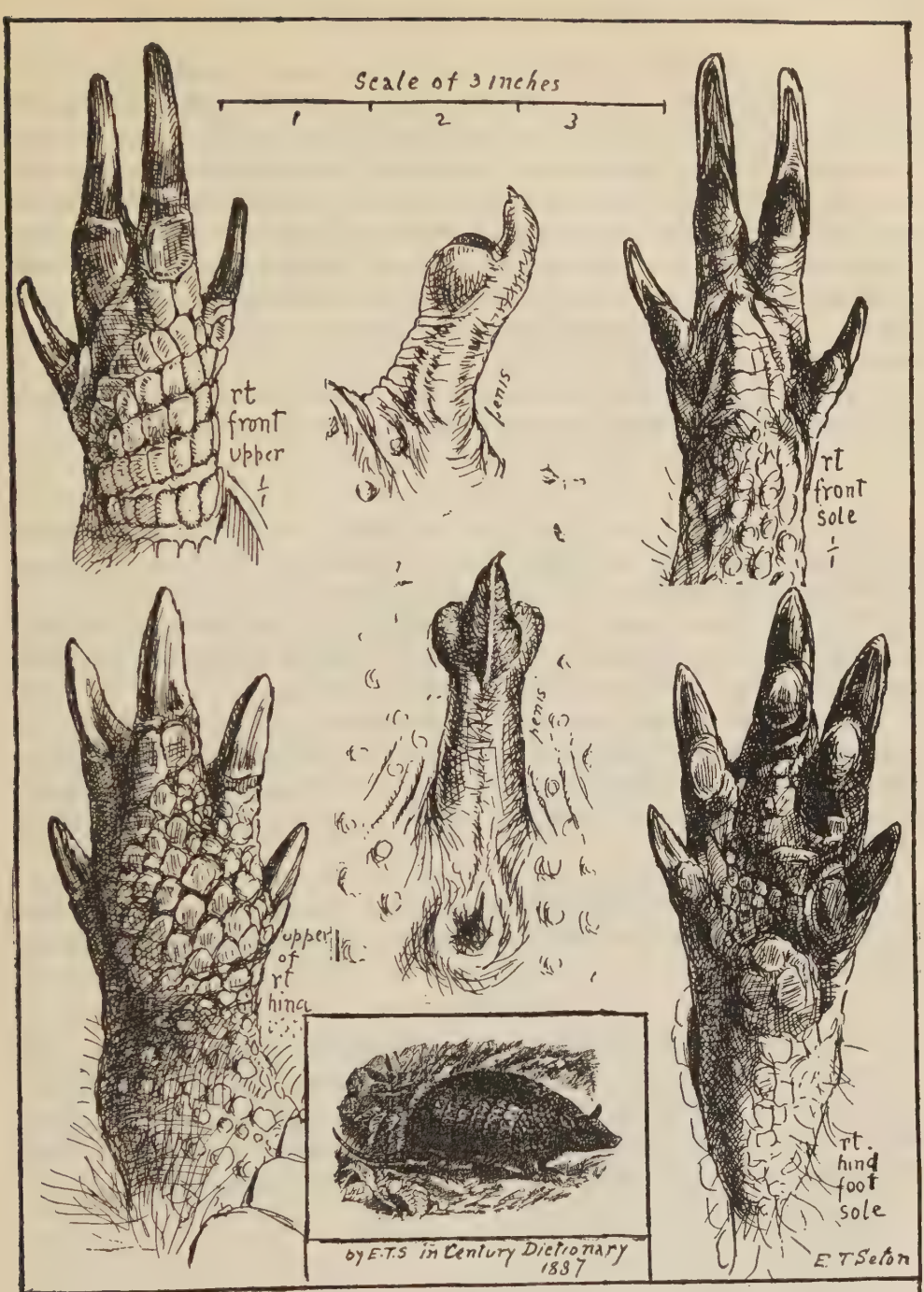

Plate CVIII. Texan Armadillo, ♂, slightly reduced

enemy, or sit on him as Hudson describes one species doing to a snake.[31] But one thing it never can or will do—that is, bite; for it has no teeth for such an attack. Audubon gives an incident, showing its disposition, as well as its methods under provocation. "In general, the Armadillo does not evince any disposition to resent an attack; and, in fact, one of them, when teased by a pet parrot, struck out with its claws, only till pressed by the bird, when it drew in its head and feet; and, secure in its tough shell, yielded, without seeming to care much about it, to its noisy and mischievous tormentor, until the parrot left it to seek some less apathetic and more vulnerable object to worry."[32]

Two manœuvres there seem to be that the Armadillo does not reckon in his repertoire—swimming and climbing a tree.

Sociability and Voice

It is a sociable little beast. "Two or three of these animals generally keep together [in their burrows], or near each other; and the Negroes always expect to kill more, when they have captured one."[33]

Old Æsop makes merry over the incongruity of the Porcupine and the Serpent living sociably together. It would be pleasant if we could hear that ancient romancer discuss the case recorded by Nelson:

"Armadillo burrows sometimes accommodate strange neighbours, as was shown by one in Texas which was dug out, and in addition to containing the owner in his den at the end, was found to be occupied by a 4-foot rattlesnake and a half-grown Cottontail Rabbit, each in a side chamber of its own."[34]

The only suggestion that this odd creature has a voice, is in this note by Audubon: "When burrowing, this species utters a slight squeak, quite faint, however."[35]

Domestication

In many parts of the Southwest, the Armadillo is caught young, and raised as a household pet, exactly as in Europe, they keep the Hedgehog—that is to kill off noxious insects. Audubon says that he saw many such, and that they appeared quite tame. Indeed the one from which he made his drawing was a pet, washed clean to have its portrait taken.

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[31] Naturalist in La Plata, 1892, pp. 72–73.

[32] Q. N. A., III, p. 223.

[33] As above, p. 225.

[34] W. A. N. A., p. 585.

[35] Q. N. A., III, p. 224.

In illustration of its house habits, as well as its Badger-like strength of limb, Audubon adds:

"A friend of ours who formerly resided in South America, had a pet Armadillo in his bedchamber, where it generally remained quiet during the day, but in the dark hours, was active and playful. One night after he had gone to bed, the Armadillo began dragging about the chairs and some boxes that were placed around the room, and continued so busily engaged at this occupation that our friend could not sleep. He at length arose and struck a light, when, to his surprise, he found boxes he had thought greatly too heavy for such an animal to stir, had been moved and placed together so as to form a sort of den or hiding place in a corner, into which the animal retreated with great apparent satisfaction, and from whence it could only be drawn out after a hard struggle, and the receipt of some severe strokes from its claws."[36]

His Way of Life

Darkness is over the dry Southwest, and black darkness fills the canyons where rocky fissures are the homes of Armadillos not a few. Each one, or each pair, maybe, has a definite home and a pathway issuing forth—deep and worn and forking like a much-branched tree, till the last small twigs are lost and merged in the foliage of the world about, perhaps a half mile from the home. And nosing, trotting, stopping, sniffing, comes the Armadillo for his nightly feast. Trot, trot, trot, he goes, silent but for the sharp taps of his toes; stopping at every promising smell, or even making slow haste in a lumbering gallop if something happens to alarm his stolid little soul. But his usual speed is slow, and not maintained. Soon he jogs along his Pig-like way.

It seems likely that the pathway he first takes, leads to some drinking place. His hoof-like tracks are thickly pattered in the mud of the margin. His nose prints show deep at places, where he was rooting in the mire for food; and oftentimes the corrugated-iron impressions of his sculptured mail give proof that the little armoured Pig did not only drink and root like his big namesake, but took mud-baths—cooling, pleasant, and cleansing.

"Other trails," says Bailey, "lead along rocky shelves, up the sides of gulches, and away from thicket to thicket; and are easily followed sometimes for half a mile till they branch and scatter, or connect with cattle trails, where the ropelike prints of dragging, horny tails are visible among the dusty cow tracks. Late in the afternoon, one occasionally meets an Armadillo trotting vigorously along a trail on his stumpy little feet, his tail dragging after him in a useless sort of way as he hurries nervously across the open

[36] Q. N. A., III, pp. 222–23.

spaces, and stops in the thickets to nose about under the leaves in search of dainties from the fragrant soil. At such times the long, pointed nose seems to be the keenest organ of sense. The little eyes, half the time buried in rustling leaves, rarely detect an object not close by and in motion. I have followed one of these preoccupied little animals for half an hour, often within 20 or 30 feet, moving only when it was rustling in the leaves, and watching its motions without being discovered or creating alarm.

"Hunters say that if you stand still the Armadillo will sometimes bump against your feet without discovering you, so short-sighted are they, and so intent on their own business. But when alarmed, they get over the ground with a rush that is surprisingly rapid considering their turtle-like build. If the first rush does not carry them to cover, and an enemy overtakes them, they curl up in an ironclad ball that is not easily uncurled."[37]

This curling into a ball is the only unpiglike part of his behaviour. His making and keeping to convenient paths, his sifting of the ooze, his wallowing in the mud, and above all, his rooting eternally—rooting for anything that smells like calories, carbo-hydrates, or nitrogenous possibilities—is eminently porcine. So that we are not surprised to learn from Audubon and Bachman that "its flesh is eaten by the Spaniards and natives. It has been described to us by Americans who ate of it during the Mexican War, to be about equal to the meat of the Opossum; we have heard, however, from South Americans, that it is considered quite a delicacy, being white, juicy, and tender; it is cooked by roasting it in the shell."[38]

Had such a weird beastie occurred in England, Ireland, or Scotland, he would have furnished the spinal column for a thousand myths and proofs of strange embodiments in diverse forms. To show that this mystic mood has a place in America, I quote from Nelson a curious myth: "The Maya Indians of the Peninsula of Yucatan have a legend that the black-headed vulture (*Catharista atrata*) in old age changes into an Armadillo. The tale runs that, when a vulture becomes very, very old, it notifies its companions that the time has come, and alights before a hole in the ground that resembles the den of an Armadillo. The other vultures bring food, and the old one remains there for a long time. Its wings disappear, the feathers are lost, and when the change is complete the newly created Armadillo enters the hole, and begins its new life. If skepticism is expressed as to this metamorphosis, the Indians point out, as proof of the legend, the similarity between the appearance of the bald pate of the vulture and that of the Armadillo."[39]

[37] Texas, pp. 55–56.

[38] Q. N. A., III, p. 225.

[39] W. A. N. A., pp. 585–86.

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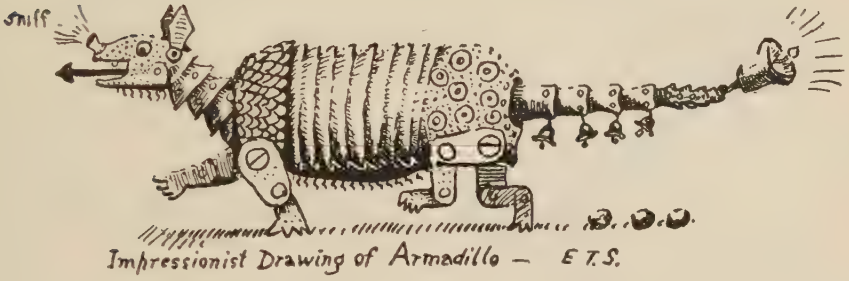

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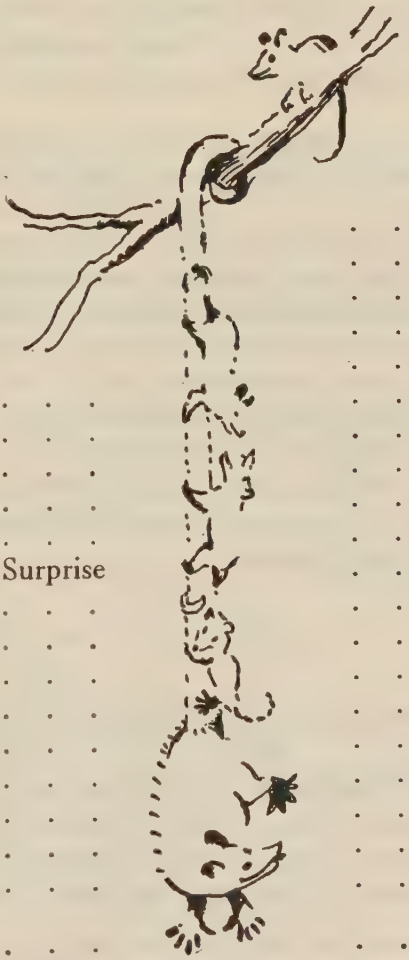

Opossum or Possum

Didelphis virginiana Kerr

(Gr. *di*, double; *delphos*, womb; L. *virginiana*, of Virginia)

Didelphis virginiana, KERR, 1792, Anim. King., p. 193.

TYPE LOCALITY—Virginia

LENAPE, *Much-woa-pingus* (Brinton and Anthony).
SANTEE SIOUX, *Singteshda-tanka* (Big Rat) (Williamson).
CHOCTAW, *Shukata* (Byington).

Opossum, Opassum, or M'possum were the Indian names in Virginia (J. Brickell Nat. Hist. North Carolina, 1737, Dublin).

The Family *Didelphidæ* or Opossums consists of marsupials of small size. They are furry creatures, with short limbs, 5 toes on each foot, naked, prehensile tail, and usually a pouch to carry the young. They are of arboreal habits. All belong to America. They are found from Lake Ontario in eastern North America to Patagonia.

The genus *Didelphis* belongs to this Family. In addition to these Family characteristics, it has the following:

Feet, with 5 distinct toes—all with claws, except the thumb on the hind foot; incisors, small and pointed; canines, large; premolars, with compressed pointed crowns.

Teeth:

$$\text{Inc. } \frac{5-5}{4-4}\text{; can. } \frac{1-1}{1-1}\text{; prem. } \frac{3-3}{3-3}\text{; mol. } \frac{4-4}{4-4} = 50$$

To the above Family and generic characters, the Possum adds the following:

Size. Total length, 29⅛ in. (740 mm.); tail, 15 in. (381 mm.); hind foot, 3 in. (76 mm.); ear, height from crown, 2 in. (51 mm.).

Weight. A female which I weighed at Cos Cob, Conn., was 12 lbs. Bailey records a large male weighing 8 lbs.[1]

[1]Mamm. D. C., Proc. Biol. Soc. Wash., May 1, 1923, p. 106.

Colour. The general impression is of a coarse-haired, grayish-white animal, with a white face and dark-socketed eyes, like holes burnt in a blanket.

Its ears are naked and black, with white or flesh-coloured outer half. Feet, black; toes, naked and flesh-coloured,[5] reminding one of the black, fingerless mitts our grandmothers used to wear. Tail, naked, scaly, and flesh-coloured.

Colour Mutations. In the *Journal of Mammalogy* for Aug., 1922,[2] Prof. Carl Hartman calls attention to the colour mutations in the Possum. Many animals, like the Eyra Cats, have two colour phases, a red and a gray. Now, it seems that the Opossum has four phases:

"1. The gray phase, with underfur black-tipped, overhair all white.

2. The black phase, with underfur also black-tipped, overhair altogether or for the most part, black.

3 and 4. Like 1 and 2, with brown pigment replacing the black."[3]

The cause of these colour variants is unknown.

The percentage of blacks in central Texas is probably near 10 per cent.

The fact that this dichromatism is individual, not racial, is evidenced by the following: C. S. Brimley says of a family taken in Union Co., N. C., Feb. 20, 1897: "Fourteen well-furred young (272–290 mm. total length) caught in hollow at base of tree, together with an adult female on Aug. 4, 1891; 7 of these had the long hairs mainly black, and the other 7 had them mainly white."[4] Hartman further writes me, Jan. 13, 1927, that he has a black female with both black and gray young in her litter.

The supposed Southern race of *virginiana*, named *pigra* Bangs, is probably nothing more than the black phase. In the kindred species, *D. marsupialis texensis*, the black phase predominates.

Albinos of this species are recorded in the N. Y. Zoological Bulletin, Nov., 1921, and by W. K. Cuyler.[5]

Races

The following forms have been recognized:

virginiana Kerr, the typical form. T. l., Virginia.

pigra Bangs, a Southern race; smaller, darker, and with longer tail. T. l., Micco, Brevard Co., Fla.

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[2] Pp. 146–49.

[3] P. 148.

[4] Journ. Mamm., Nov., 1923, p. 263.

[5] As above, May, 1924, p. 130.

marsupialis Linnæus, a dark form, with longer, blacker tail, and wholly black ears. Chiefly Mexican, but found in southwestern Texas. Appears in gray coat, and in black coat. Usually considered a quite distinct species, but not known to be different in habits. T. l., Northern Mexico, but the race *texensis* has Brownsville, Texas, for type locality.

History

The earliest notice I find of this creature is in Purchas' "Pilgrimages," 1616, where he describes the beasts of Virginia; and, among them, the Opossum, as follows:

"The Opassom, hath a head like a Swine, a tayle like a Rat, as big as a Cat, and hath vnder her belly a bag, wherein she carrieth her yong."[6] To which he adds on p. 1007, discussing the strange creatures of Nicaragua: "Another there is with a naturall purse vnder her belly, wherein she putteth her yong; it hath the bodie of a Fox, handed and footed like a Monkey."

Another quaint and early description appears in Baron Lahontan's Book, where he says: "The Ossa are little Animals like Hares, and resemble 'em in every thing, excepting the Ears and Hind-feet. They run, and cannot climb. Their Females have a Bag under their Belly, where their young ones enter upon a pursuit, in order to save themselves along with the Mother, who immediately betakes herself to flight."[7]

Range

This is the only species of Opossum occurring in the United States; for *marsupialis* is now considered to be merely a Southern form. It occupies all the wooded parts from Connecticut, Lake Ontario, southern Michigan, southern Wisconsin, Iowa, and eastern Nebraska, south to the Gulf Coast, west to the 100th meridian, through eastern Mexico and into the Tropics. It has recently been introduced in central California, as we shall see. Although scarce in the northern parts of its range, it is abundant and well known in Dixieland. These main facts are set forth on Map XVII (p. 639).

Ten years ago, I made another map which gave a much more restricted range. Except as a rare straggler, it was not then found north of Chicago, or east of the Hudson River. Ten years from now, a new map will be needed, for the Opossum is multiplying and spreading. It has solved the present problem of the high cost of living; and each year is adding to its range.

[6] Eighth Book, Chap. 5, § III, p. 945.

[7] New Voyages to North America, 1703, I, pp. 234–35.

Recent Records

Vermont. "A full-grown Opossum was caught by A. A. Roberts, a professional trapper, at Dorset, Vt., in the heart of the Green Mountains, in mid-December, 1920, long after the ground and streams had become frozen. The skin was seen by the writer."[8]

This same writer reports: "Another of the animals, a large male, was captured in a Fox trap late in October, 1921, at Mount Horrid, in Rochester, Vt., by Dexter W. Kathan, of Putney, Vt. The second animal was taken about 45 miles north of the scene of the first capture."[9]

New Hampshire. Dr. Francis Harper, of the Boston Society of Natural History, writes me, June 2, 1926: "Our taxidermist, Mr. John D. Smith, tells me that he caught a male in a Fox trap at Warner, N. H., on Dec. 10, 1910."

Massachusetts. In the Boston Society of Natural History Museum is a specimen taken at Newton Center, Mass., Feb. 15, 1925. This is recorded by Dr. G. M. Allen, in the Bulletin of the Society, April, 1925, p. 15.

Connecticut. At Cos Cob and Greenwich, during the last 20 years, I have seen over a dozen specimens taken, and have heard of many more. One or two of them I have kept in my menagerie. They are usually captured by Coon and Rabbit hunters, whose Dogs tree them at night. They were unknown 30 years ago.

Long Island. On Long Island, they are known to be abundant now. They were unknown there in primitive days, and were introduced by sportsmen quite recently; this is understood to mean in the '70's.

New York. "In the Highlands, the Opossum has always been fairly common since my boyhood; and hence, long before its too 'successful' introduction on Long Island, N. Y."[10]

Dr. C. H. Townsend says, in 1912: "The Possum is apparently extending its range northward. John Burroughs writes of finding it at West Park, N. Y., where it was previously unknown."[11]

Michigan. Norman A. Wood gives two records for Ann Arbor in 1912, and says: "These records are the 11th and 12th known to the writer from this county alone, and it is no doubt just as common throughout the southern part of the Lower Peninsula. We have records as far north as Ottawa, Genesee, and southern Isabella counties."[12]

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[8] George L. Kirk, Rutland, Vt., Journ. Mamm., May, 1921, p. 109.

[9] As above, May, 1922, p. 115.

[10] Mearns, Fauna Hudson Highlands, Am. Mus. Nat. Hist., Sept. 9, 1898, p. 330.

[11] Making Friends, p. 23.

[12] Notes on Mich. Mamm., 14th Rep. Mich. Acad. Sci., 1912, p. 163.

In 1922, the same naturalist writes: "This species is rare in the county. One was taken by my father, Jessup S. Wood, in 1845, in Lodi Township. We have later records for Ann Arbor, Dexter, Manchester, Saline, and Scio Township. The last recorded specimen was taken by some boys in Nov., 1921, just south of the Oakland County line."[13]

Illinois and Wisconsin. "The Virginia Opossum is common in wooded localities in southern Illinois, and occurs sparingly in northern Illinois and southern Wisconsin."[14]

Iowa. Senator Lafayette Young of Desmoines, Ia., on the *Lusitania*, Feb. 1, 1915, told me that "Opossums are now common as far up as Desmoines. It first came about 10 years ago."

Saskatchewan. J. S. Charleson, of Brandon, Man., writes me, May 25, 1925, that an Opossum was caught by a boy, Reginald White, near Antler, Sask., about Christmas, 1924. He kept it alive for a short time in the stable. It was very thin, and died, apparently from starvation. Its weight was 4 pounds. Length, 29½ inches; tail, 10½ inches. It was a female. This specimen was mounted by Charleson, and is carefully preserved.

Colorado. Merritt Cary records the taking of one near the head of Caddoa Creek in the winter of 1903–04. Full details are given in his Biological Survey of Colorado, *N. A. F.*, 33, 1911, pp. 52–53.

The Possum in California

The introduction of the Opossum into California was apparently the result of accident. But the creature has thriven, and is spreading rapidly, like most foreigners in California.

It has appeared in two widely separated localities—one, in and about Santa Clara, near San Francisco, and the other, about Los Angeles. In the first region, they are known to have been introduced. They may also have been introduced in the South, but at present, no evidence is at hand to prove it.

In 1906, the species was first taken near Whittier, Los Angeles Co. With increasing frequency, others were captured in the region.[15]

In Ventura Co., the creature was plentiful in 1924.[16]

The northern implantation is better known. In 1910, J. R. Kocher, a jeweller in San José, imported from Tennessee, 7 Possums, of which 5 escaped. Other captives are believed to have escaped later. They have spread rapidly,

[13] Mamm. of Washtenaw Co., Mich., Univ. of Mich., July 10, 1922, p. 5.

[14] C. B. Cory, Mamm. Ill. & Wis., p. 52.

[15] Etta V. Little, Cal. F. & G., Jan., 1916, pp. 46–47.

[16] George P. Austin, Oxnard, Calif., Cal. F. & G., Jan., 1924, p. 46.

PLATE CIX.—POSSUM UP A TREE

From drawing by E. T. Seton in collection of N. Y. Zoological Society

and are now reported from the following counties: Santa Clara, San Mateo, San Benito, Amador, Alameda, Tulare, as well as Los Angeles and Ventura.

Joseph Grinnell writes:[17] "It is believed that fully 200 Possums are accounted for to the present date, as killed or captured; and in spite of this, the species appears to be spreading and multiplying at a rapid rate.

"It would appear that the Possum has found in this part of California congenial climatic conditions, at least sufficiently near those of its native habitat in the southeastern United States so that it is thriving. It is rather doubtful if we are to consider ourselves lucky in having acquired this addition to our mammal fauna. In fact, it is quite possible that we may live to greatly regret the circumstances which secured its introduction into our State."

Haunts

There are three essentials to make a Possum paradise—food, woods, and water. All its far-flung searching parties have followed the rivers through more or less timber. Where the timber ceases, or the water ends, the Possum halts its onward march.

Rocky uplands are not to its taste, but a swamp it loves; and where there are hollow trees near by for lodging, the Possum is content to take a chance on the food question.

One other limitation, of course, is observed: This haunt must not be farther north than the north edge of the Alleghanian Fauna.

Numbers

Hundreds of men have spent their lives in Possum country, and yet have never seen a live, loose Possum. The creature is so strictly nocturnal, and so secretive, that it is seldom found till trapped, or else treed by some night-roving Dog.

Bachman, by offering rewards to the darkeys about his South Carolina home, was able to secure 35 alive in three nights.[18] Half a dozen were frequently taken in a single night hunt in the old plantation days.[19] He calls it a "very abundant species," in South Carolina.[20]

Bailey says the Possums in Texas were "more or less abundant throughout their range."[21] James H. Gaut "found them abundant in the Big Thicket

[17] George P. Austin, Oxnard, Calif., Cal. F. & G., April 10, 1915, pp. 1–3.

[18] Q. N. A., II, p. 119.

[19] As above, p. 115.

[20] As above, p. 119.

[21] Texas, p. 56.

northeast of Sour Lake [Texas"].[22] They are rather a nuisance to the trapper of the region, because they continually get into the traps set for more valuable game.

In Jersey, the species is general, but not abundant, according to various accounts.

It is probably now as plentiful as ever it was in Dixieland; yet we have no means of estimating its numbers.

Home Range

Almost as slow as a turtle, seems the woolly Roasting-pig, so that we should expect it to have a very limited home range.

Bachman says: "Although a slow traveller, the Opossum, by keeping perseveringly on foot during the greater part of the night, hunts over much ground; and has been known to make a circle of a mile or two in one night. Its ranges, however, appear to be restricted or extended, according to its necessities; as when it has taken up its residence near a cornfield, or a clump of ripe persimmon trees (*Diosperos virginiana*), the wants of nature are soon satisfied; and it early and slowly carries its fat and heavy body to its quiet home, to spend the remainder of the night and the succeeding day in the enjoyment of a quiet rest and sleep."[23]

The Tail

The Possum is the only animal on our list that can hang by its tail. There are a few in Australia and one or two in the Old World that are blessed with this fifth hand; the great body of them are in South America, where swinging by the tail is a specialty. But the only tail-hanger that crosses the Mexican border into the United States, is the homely, humping, sluggish, stupid Possum.

The strength and service of this "little behind hand" seem to be greater than those of any one of its feet; for it can hang by the tail while its body and legs swing free. "In this manner," says Bachman, "we have observed it gathering persimmons with its mouth and forepaws, and devouring them whilst its head was downwards and its body suspended in the air; holding on sometimes with its hind feet and tail, but often by the tail alone."[24]

Personally, I have always been disappointed when I tried to make a Possum perform with its tail. I never saw one hang by it, or show any clear consciousness that it had such a member.

[22] Texas, p. 57.

[23] Q. N. A., II, p. 111.

[24] As above, p. 111.

However, Dr. Townsend writes, concerning a captive which he observed: "We discovered by experiment that he can hang by the tail perfectly, provided that at least half of the tail has hold of the branch, and that the branch is thick enough. There is not enough grip in the extreme end of the tail to support his weight; and the tail is too thick for a perfect grasp if the branch is slim."[25]

An entirely new observation on the use and power of the tail is supplied by Leon L. Pray of the Field Museum. Describing the habits of a caged Opossum, he says:

"When the fall days began to grow cold, I gave this fellow a thick carpet of autumn leaves in his box cage. Though he ate heartily of meat scraps, fruits and vegetables, he was not contented. When not sound asleep in his favourite corner, he pounded solemnly around and around his cage like a wild Tiger, with a funny, preoccupied look on his grinning face.

"One morning, when I glanced into his cage I was surprised to see him pacing around his beat with a large bunch of leaves tightly rolled up in his long, prehensile tail. He carried this bundle so long, around and around in tireless pace, that I left him without learning the object of his action. Later he repeated this carrying of a bundle of leaves in his tail a number of times. I noticed that he had made a half-hearted attempt to build a nest in one corner; but had abandoned the idea, and slept anywhere that he happened to be when drowsiness overcame him.

. . . . . .

"The accompanying sketch shows accurately the manner in which the tail was employed in carrying bundles of leaves."[26] (Plate CXI, p. 883.)

Den

The home of the Possum is a hole—anywhere—in anything—high or low—so it be a hole that is dry and warm, not far from timber, and handy to water.

Bachman says: "This animal is a tolerable digger, although far less expert in this quality than the Maryland Marmot. Its den is usually under the roots or stumps, when the ground is so elevated as to secure it from rains and inundations. The hollow of a large fallen tree, or an opening at the roots of a standing one, also serve as a convenient place for its nest. . . . On firing into a Squirrel's nest which was situated in the fork of a tree some 40 feet

[25] Making Friends, p. 23.

[26] Journ. Mamm., May, 1921, pp. 109–10.

from the ground, we brought down an Opossum, which had evidently expelled its legitimate occupant.

"The Florida Rat is known to collect heaps of sticks and leaves, and construct nests sometimes a yard in diameter and 2 feet high; these are usually placed on the ground, but very frequently on the entangled vines of the grape, smilax, and supple jack (*Ziziphus volubilis*). In these nests, an Opossum may occasionally be found, dozing as cozily as if he had a better right than that of mere possession."[27]

They have been found sleeping in hollow trees, hollow logs, holes in the ground, in thickets, curled up on the leaves, perched in high crotches of trees, under logs or woodpiles about buildings, in barns, under floors, in drain pipes—every possible shelter, with every possible variation dictated by the weather.

The lining of the nest is a matter of importance, for the "woolly Shoat" loves its comfort. Bachman says: "The material which we have usually found composing this nest along the seaboard of Carolina, is the long moss (*Tillandsia usnoides*); although we have sometimes found it composed of a bushel or more of oak and other leaves."[28] This is carried in by the tenant. The manner of collecting and transporting the bedding had never been observed, until the account by Leon L. Pray furnished very unexpected light.

So far as known, the female alone regulates the home.

Mating, Gestation, and Breeding

Whether the Possum pairs or is promiscuous, no one knows. Usually the female is found alone with the brood. If anyone reports definitely and in detail, the presence of a male with a female during the time the young are in the pouch, it will at least be evidence pointing toward monogamy.

The breeding of the Opossum has been made the subject of more fairy tales and fantastic explanations than any other perfectly simple natural process discussed in this work. Because the male organ happens to be forked, it was assumed that the nostrils, not the sex-organ of the female was the receptable of the "pollen." Because the young are exceedingly small prior to birth, it was stated that no man had ever found them *in utero*. Because they were found in the mother's pouch, it was supposed that she blew them there out of her nose, etc., etc.

The whole process of copulation and reproduction is as in other quadrupeds—except in one important particular. Most of our young animals are

[27] Q. N. A., II, p. 113.

[28] As above.

raised at the breast, and cuddled in the mothers' arms. But in the Possum it is otherwise; its babies look like abortions—born too soon; they are never mother-cuddled; and every little Possum is an incubator baby.

The earliest careful investigator of these happenings in Possum life was Bachman himself. His account impresses us, not only with the strangeness of the Possum babyhood, but also with the lifelong patience and unbounded opportunities with which Bachman himself was blessed.

He was the first naturalist to discern and report on the young *in utero*.

"We have been so fortunate," he says, "in 5 instances, as to have procured specimens in which the young were observed in this position; and therefore feel prepared to speak with certainty. We are not aware that the young of the Virginian Opossum had been previously detected in the uterus."[29]

Next he set about ascertaining the time of giving birth.

"We ascertained, by having a number of females procured with young in their pouches, that about the close of the first week in March—a little earlier or later, according to the age of the individual, or warmth, or coldness, of the previous winter—was the time when, in this latitude, this event usually occurs. Here, however, another difficulty presented itself, which for several successive seasons, thwarted us in our investigations. In the third week of February, 1847, by offering premiums to the servants on several neighbouring plantations, we obtained in 3 nights, 35 Opossums, but of that number, there was not a single female. A week afterwards, however, when the young were contained in the pouch, we received more females than males.

"From this circumstance we came to the conclusion that during the short period of gestation, the females, like those of some other species of quadrupeds—particularly the American Blackbear—conceal themselves in their burrows, and can seldom be found."[30]

From these and other observations, he decided that 15 days was the period of gestation. But Professor Hartman points out the difference between copulation and ovulation; then says: "I have accumulated considerable data on the rate of development, that leads me to believe that 12 to 13 days is very nearly correct for this period (gestation)."[31]

Broods

Since broods have been found from January to July, and it takes 2 months for the young to reach self-sufficiency, it is commonly stated that

[29] Q. N. A., II, p. 119.

[30] As above.

[31] Œstrous Cycle in the Opossum, Am. Journ. Anat., Vol. 32, No. 3, Nov., 1923, p. 366.

three broods each season are the rule, at least in the South. But such an inference gives the mother no rest time between broods. Fuller investigation may prove that, except in the dark days of November and December, young are born the year round, but the same mother does not bear them so continuously.

Probably two broods per season for each mother is the rule in the South, and in the Northern States, but one.

One of the most interesting observations showing that a new brood may arrive while yet the first have need of the mother's care, is given by Bachman as follows:

"We consider the early parts of the three months of March, May and July, as periods in South Carolina when they successively bring forth; it is even probable that they breed still more frequently, as we have observed the young during all the spring and summer months. In the month of May, 1830, whilst searching for a rare species of *coleoptera*, in removing with our foot some sticks composing the nest of the Florida Rat, we were startled on finding our boot unceremoniously and rudely seized by an animal which we soon ascertained was a female Opossum. She had in her pouch 5 very small young, whilst 7 others about the size of full-grown Rats were detected peeping from under the rubbish."[32]

Young

"The young, when first born," says Bachman, "are naked and flesh-coloured; the eyes, together with the ears, are covered by a thin integument through which these organs and the protuberances of the ears are distinctly visible. The mouth is closed, with the exception of a small orifice, sufficiently large to receive the teat, which is so thin and attenuated that it seems no larger than the body of a pin. Length of body, $\frac{7}{12}$ of an inch; of tail, $\frac{2}{16}$. The nails, which can [not] be seen with the naked eye, are very distinct when viewed with a microscope, and are of a dark brown colour, small and much hooked. The nostrils are open; the lungs filled with air; and when placed in water, the young float on the surface.

"The number of young usually found in the pouch appear to be less than those that are born. The highest number we have found in the pouch was 13, the smallest, 6; whereas the preserved uterus brought to us by Mr. Fisher, contained 15. In all such cases, where a greater number of young are produced than there are teats, the last of the brood must inevitably perish, as those that are attached appear incapable of relinquishing their hold.

"The manner in which the young at birth reach the pouch, and become

[32] Q. N. A., II, p. 124.

attached to the teats, has been the subject of much speculation and inquiry. We had an opportunity of examining this process in part, without, however, having been aware at the time that it was going on. We intended to dissect a small female Opossum, which had been a few days in our possession; but ascertained in the morning at 7 o'clock on the day our examination was to have been made, that she had 3 young in her pouch; supposing from her small size, that she would produce no additional number, we concluded to spare her life. She was confined in a box in our study; when we occasionally looked at her, we found her lying on one side, her shoulders elevated, her body drawn up in the shape of a ball; the pouch was occasionally distended with her paws—in this position the parts reached the edge of the pouch; she was busily employed with her nose and mouth licking, as we thought, her pouch, but in which, we afterwards ascertained, were her young.

"At 6 o'clock in the afternoon, we were induced to examine her again, in consequence of having observed that she had for several hours appeared very restless, when we discovered that she had added 4 more to her previous number, making her young family now to consist of 7. With no inconsiderable labour and the exercise of much patience, we removed 3 of the young from the teats, one of which perished under the process, we replaced the 2 living ones in the pouch; at 9 o'clock examined her again and found both the young once more attached. We came to the conclusion that she shoved them into the pouch, and with her nose or tongue moved them to the vicinity of the teats, where by an instinct of nature, the teat was drawn into the small orifice of the mouth by suction. We observed subsequently that a young one that had been extracted from its parent a few moments before the time when it would have been born, and which had been rolled up in warm cotton, was instinctively engaged in sucking at the fibres of the cotton, and had succeeded in drawing into its mouth a considerable length of thread."[33]

Very good, so far as it goes; quite correct in observation; faulty only in the inference. The honour of discovering the missing link in the chain of interesting events was reserved for Prof. Carl Hartman of the State University of Texas (now of Johns Hopkins, Baltimore), from whose valuable papers on Possum Reproduction (see References) I quote extensively as follows:

How They Reach the Pouch

"A series of observations and experiments during the last four or five breeding seasons of the Opossum, has enforced the conviction that the young

[33] Q. N. A., II, pp. 121–22.

reach the pouch and find the teat by their own efforts, and are not placed on the teats by the mother's tongue or lips. . . .

"On several occasions, I experimented with newly-born pouch-young, gently removing them from the teats to which they had firmly attached themselves by means of their powerful tongues. I quote from my notes in one case. . . .

"'Female tied down, and pouch opened. Young which were removed from teats, crawled about, moving hands alternately, as in swimming. Were able to crawl among hairs, and find teats by their own efforts. One specimen, removed three times, found teat each time; and 3 others found teats after wandering about.'

"These experiments certainly argued strongly in favour of some little independence of action on the part of these 'embryos,' a term that Dr. [Charles D.] Meigs would have us abandon when speaking of these 'breathing, sanguiniferous, digesting pouch-young.'"

On Feb. 6, 1917, while Hartman was examining a female under anæsthesia, the young were expelled. "They were mostly still alive," he says, "entangled in fœtal envelopes, and immersed in the fœtal liquid. To some of the fœtuses, the umbilicus was still attached; others were free, but no navel could be seen in any case. None of the fœtuses, even after being freed of membranes and liquids, could crawl about, as they were apparently drowned in their own embryonic fluid. It seemed likely, therefore, that the embryos, on emerging from the vagina, need the assistance of the mother to lick away the fluid expelled from them; and this was later verified by actual observation."[34]

The Birth of a Brood

Hartman continues: A specimen "was brought to the laboratory, Feb. 2, 1920, having been captured uninjured several nights before. She was a healthy female of medium size. . . . I recognized her as pregnant, and likely to give birth within several days. . . .

"At 10.30 P. M., Feb. 6, 1920, the animal showed signs of restlessness, and soon began cleaning out the pouch, which she did about four times. Then began a short series of spasmodic contractions of the abdominal wall, after which she came to a sitting posture with legs extended. . . .

"After assuming the sitting posture, our specimen bent her body forward, and licked the vulva; however, her position at this time was such that we could not see the embryos, which very likely passed into the pouch with the first licking of the genital opening. Hence, we went to the outside where

[34] Studies, 1920, pp. 252–53.

PLATE CX.—POSSUM POSES

By E. T. Seton

we could plainly hear her lap up the chorionic fluid; then suddenly a tiny bit of flesh appeared at the vulva, and scampered up over the entanglement of hair into the pouch, to join the other fœtuses, which now could be seen to have made the trip without our having observed them. Unerringly, the embryo travelled by its own efforts. Without any assistance on the mother's part, other than to free it of liquid on its first emergence into the world, this 10-day-old embryo, in appearance more like a worm than a mammal, is able, immediately upon release from its liquid medium, to crawl a full 3 inches over a difficult terrain. Indeed, it can do more: after it has arrived at the pouch, it is able to find the nipple amid a forest of hair. This it must find—or perish."

On fuller examination, he found that "the pouch contained a squirming mass of 18 red embryos, of which 12 were attached, though 13 might have been accommodated. The remainder were, of course, doomed to starvation. Even some of these unfortunates, however, held on with their mouths to a flap of skin, or to the tip of a minute tail, while several continued to move about.

"With the mother under the influence of ether, we now gently pulled off a number of embryos from the teats in order to test their reactions. The teats had already been drawn out from about a millimeter in height to double that length, doubtless by the traction of the embryo itself, for the bottom of the pouch certainly presented a busy scene with each member of the close-pressed litter engaged in very active breathing and sucking movements.

"One detached young, placed near the vulva, crawled readily back into the pouch. Two or three others regained the teats after some delay; and one wanderer, which lost out in the first scramble, found a vacated teat and attached itself even after 20 minutes' delay showing that the instinct to find the teat persists for some time. If the skin be tilted, the embryos can be made to travel upward and even away from the pouch, for they are negatively geotropic.

"For locomotion, the embryo employs a kind of 'overhand stroke,' as if swimming, the head swaying as far as possible to the side opposite the hand which is taking the propelling stroke. With each turn of the head, the snout is touched to the mother's skin as if to test it out; and if the teat is touched, the embryo stops, and at once takes hold.

"It is thus apparent that the Opossum embryo at birth possesses not only fairly well-developed respiratory and digestive systems, but that it has attained a neuro-muscular development sufficient to enable it to find its place in the pouch where food and shelter await it."[35]

[35] Studies, 1920, pp. 254–56.

Number of Pouch Young

According to numberless observers, 6 or 7 is the usual number of young found in the pouch. Nevertheless, as Hartman says, "most female Opossums possess 13 teats, of which usually only the posterior 11 are functional. I have often found as many as 11 pouch young attached; but only in 2 cases, as many as 12. Doctor Meigs, on one occasion, found 13. I have seen litters consisting of 15, 17, and 18 newly-born young in the pouch, with as few as 7 attached to teats; and have removed from pregnant uteri as many as 22 normal fœtuses near term."[36] That is, half of the brood are early doomed to perish—maybe on their first day. This illustrates the reckless slaughter of innocents that we continually find in nature—the remorseless selection of the strongest to perpetuate the race.

A remarkable exception to the rule of small broods is furnished by Bailey, who records that a Possum he sent to the National Zoo, Aug. 28, 1917, was found to have 17 young, probably several weeks old, which had just emerged from the pouch.[37]

The Young in Mother's Care

The growth of the young is surprisingly rapid. Bachman tells of unborn but near-full-term young, taken Feb. 14, 1848, each weighing $2\frac{1}{2}$ grains; others taken Feb. 18th, weighed 3 grains. After citing other cases of even greater weight, he thus summarizes: "The weight, then of the young Opossum at the moment of birth, is between 3 and 4 grains." [38]

"We weighed the largest young one," he says, "at a week old, and found that it had increased from $3\frac{3}{4}$ grains to 30 grains. Length of head and body, exclusive of tail, $1\frac{1}{4}$ inch; tail, $\frac{1}{2}$ inch. The young at this age are very tenacious of life; as on removing 2, they remained alive on the floor without any covering through a cool night, in a room containing no fire; and still exhibited a slight motion at 12 o'clock on the following day.

"The teats of the mother after the young had been gently drawn off measured an inch in length, having been much distended, and appeared to have been drawn into the stomach of the young. The pouches of the young females were quite apparent; they used their prehensile tails which could now be frequently seen entwined around the necks of others. At 12 days old, the eyes were still closed, a few hairs had made their appearance on the mous-

[36] Studies, 1920, p. 256.

[37] Mamm. D. C., Proc. Biol. Soc. Wash., May 1, 1923, p. 106.

[38] Q. N. A., II, p. 120.

tache; the orifices of the ears were beginning to be developed, and the nails were quite visible and sharp.

"When the young are 4 weeks old, they begin from time to time to relax their hold on the teats, and may now be seen with their heads occasionally out of the pouch. A week later and they venture to steal occasionally from their snug retreat in the pouch; and are often seen on the mother's back, securing themselves by entwining their tails around hers. In this situation she moves from place to place in search of food, carrying her whole family along with her, to which she is much attached, and in whose defense she exhibits a considerable degree of courage, growling at any intruder, and ready to use teeth with great severity on man or Dog.

"In travelling, it is amusing to see this large family moving about. Some of the young, nearly the size of Rats, have their tails entwined around the legs of the mother, and some around her neck; thus they are dragged along. They have a mild and innocent look, and are sleek, and in fine condition; and this is the only age in which the word 'pretty' can be applied to the Opossum. At this period the mother, in giving sustenance to so large a family, becomes thin, and is reduced to one half her previous weight.

"The whole family of young remain with her about 2 months, and continue in the vicinity till autumn. In the meantime, a second and often a third brood is produced, and thus 2 or more broods of different ages may be seen, sometimes with the mother, and at other times not far off. . . .

"The female produces young at a year old. The young born in July do not bring forth as early as those born in March, but have their young as soon as the middle of the succeeding May."[39]

Voice

So far as recorded, the Possum is one of the most silent of our animals. It has no call note, no note of recognition or of anger, except at rare times a low growl; or occasionally a faint hissing, when, with mouth wide open, it views the approach of a stranger.

Nevertheless all this is but the casual and superficial observation of persons who have had but fleeting glimpses of the creature under circumstances when its evident policy was to keep quiet. Some day our younger and more minutely observant naturalists will tell us of its extensive list of sounds, with calls to mate or young ones—yes, even a love-song for the love-time. Has it not vocal apparatus and strongly marked instincts and desires that need expression? From this we may argue that—just as surely

[39] Q. N. A., II, pp. 123–24.

as sundry planets have been predicted because of their inevitability—the Possum will be shown to have a voice and a vocabulary, all his own.

Gait—Waddle and Swing

About 40 years ago, I saw my first Possum. It was dead, and had been brought me as material for a drawing. "But," I said to my friend, "I never saw one alive. I don't know whether it's an active, alert thing like a Squirrel, leaping from bough to bough, or a slow, cautious thing like a Coon." The answer was, "It's just the slowest, stupidest, crawlingest thing that ever was in the woods, and it's like nothing but itself."

On the ground "the gait of the Opossum is slow, rather heavy and awkward," as Bachman says. "It is not a trot like that of the Fox, but an amble or pace, moving the two legs on one side at a time. Its walk on the ground is plantigrade, resting the whole heel on the earth. When pursued, it . . . goes forward at a rather slow speed . . . never . . . increasing it to a leap or canter, but striving to avoid its pursuers by sneaking off to some thicket or briar patch. When, however, it discovers that the Dog is in close pursuit, it flees for safety to the nearest tree, usually a sapling; and unless molested, does not ascend to the top, but seeks an easy resting place in some crotch not 20 feet from the ground where it waits silently and immovably, till the Dog, finding that his master will not come to his aid, and becoming weary of barking at the foot of the tree, leaves the Opossum[40] to live its own life.

The Low-brow Possum

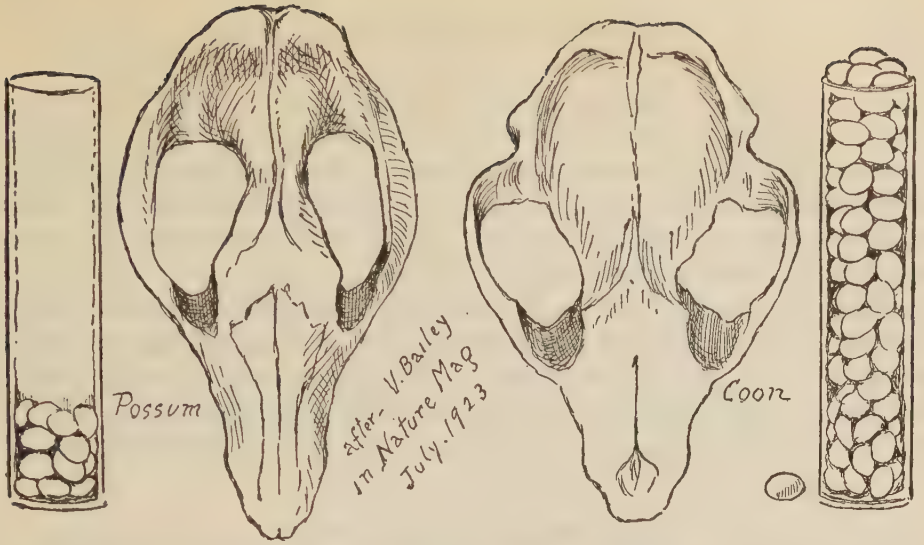
As to intelligence, most observers agree that the Opossum has none. It is a silly grinning idiot.

Bailey, by using beans, measured a Possum brain-pan to compare its equipment with that of a similar-sized Coon. The Possum's wit-box held but 25 beans, while that of the Coon held 150; i. e., the latter had 6 times as much gray matter as the Possum. (See Plate CXI, p. 883.)

Measuring by the same standard, I got the following results: Possum, 21 beans; Skunk, 35; Arctic Hare, 46; Hog-nosed Skunk, 50; Porcupine, 70; Kitfox, 120; Redfox, 198; Coyote, 325; while the Gray-wolf rejoices in a brain of 438 bean-power. Of course, this gauge is not perfect, as it takes no account of the larger size of the last two.

The Possum is the most hopeless fool of the woods. It will enter any kind of trap, no matter how often it has previously suffered from such contrivances; and when caught by some hard-gripping steel, it has not wits enough

[40] Q. N. A., II, p. 110.



Showing relative brain capacities— Possum 25 beans - Coon 150 beans

Possum carrying bedding. From life by Leon L Pray.

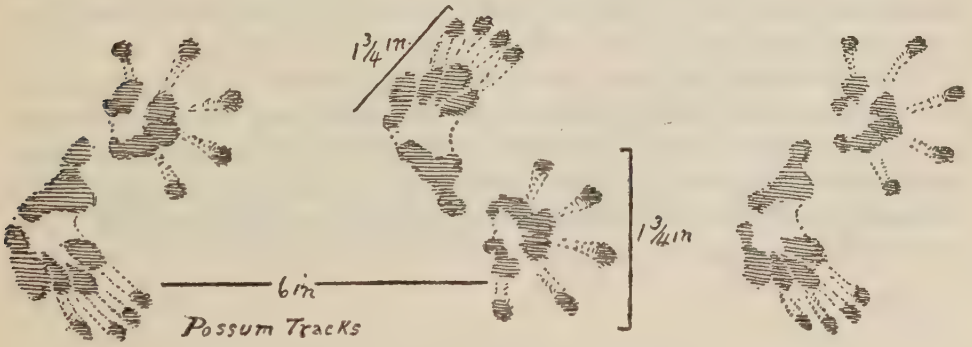


PLATE CXI.—DETAILS OF POSSUM

even to get mad; it simply looks bored, scared, and non-resistant. We find in this a melancholy proof that, in the struggle for life, wits count for less than fecundity—a complete, logical application of which principle warns us that Europe will be wiped out by Asia, and the proud blood of America by the teeming, proletariat Wop. And shall I add a sinister and disquieting thought? This world-winner is a pacifist.

Bailey caught a female in one of his trapping trips in Texas. She "showed no disposition to fight or defend herself." But he was reminded that there are exceptions even to Possum pacifism, for "an old male, caught a day or two later, fought viciously, growling, and biting anything that came within reach, actually cutting deep gashes in the hard-wood stock of my gun."[41]

Behaviouristic Details

Solitary. The Possum is a strictly solitary animal; no one has yet reported two adults together, even during the breeding season.

During summer, it is common to find an old Opossum and a lot of smaller ones in the same den; but these, of course, are her young, and, by this time, they are three-quarters grown. In the autumn, they usually separate, and each goes forth alone to seek his fortune.

A Surprise. Mrs. M. D. Bakewell, sister-in-law of the great Audubon, has sent me in a personal letter from Pewee Valley, Ky.,[42] the following delightful incident which seems to contradict the above rule:

"A relative of mine, Mr. Thomas Kennedy, living on a farm near Louisville, had an old-time slave cook called Aunt Mimy. She reigned queen in her cabin kitchen outside, as was the way in old times. One cold winter, she had a pet Possum, which abided behind the stove in a box of rags, a favourite form of upholstery with our country darkeys. The weather became intensely, exceptionally cold. All of a sudden, the pet Possum left his warm quarters; and, as days passed by without his return, Aunt Mimy grieved for him as one of the 'loved and lost.'

"After he had been gone for about a week, she heard a little scratching on her kitchen door, and when she opened it, there was her Possum come back—and behind him was a train of 9 of his brethren. He led them straight round behind the stove, whither, no doubt, he had invited them by glowing accounts of the warmth and hospitality of that spot. Who now can doubt his power of language?"

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[41] Texas, p. 58.

[42] Oct. 3, 1902.

A Night Prowler

"Like the great majority of predacious animals," says Bachman, "the Opossum is nocturnal in its habits. It suits its nightly wanderings to the particular state of the weather. On a bright starlight or moonlight night, in autumn or winter when the weather is warm and the air calm, the Opossum may everywhere be found in the Southern States, prowling around the outskirts of the plantation, in old deserted ricefields, along water courses, and on the edges of low grounds and swamps; but if the night should prove windy or very cold, the best-nosed Dog can scarcely strike a trail."[43]

Playing Possum

Many animals and many insects "play Possum." It is a well-known pacifist trick; but none other than the present creature, has made such a profound, lifelong, and successful study of the ruse which, in accordance with the established custom of science, has been named for its chief exploiter.

"The habit of feigning death," says Bachman, "to deceive an enemy, is common to several species of quadrupeds; and we, on several occasions, wirnessed it in our common Red-fox (*V. fulvus*). But it is more strikingly exhibited in the Opossum than in any other animal with which we are acquainted. When it is shaken from a tree and falls among grass and shrubbery, or when detected in such situations, it doubles itself into a heap, and feigns death so artfully, that we have known some schoolboys carrying home for a quarter of a mile an individual of this species, stating that when they first saw it, it was running on the ground, and they could not tell what had killed it. We would not, however, advise that the hand should, on such occasions, be suffered to come too familiarly in contact with the mouth, lest the too curious meddler should on a sudden be startled with an unexpected and unwelcome gripe."[44]

Similarly Nelson says: "They are rather slow-moving, stupid animals, which seek safety by their retiring nocturnal habits, and by non-resistance when overtaken by an enemy. This last trait gave origin to the familiar term 'playing Possum,' and is illustrated by their habit of dropping limp and apparently lifeless when attacked. Despite this apparent lack of stamina, their vitality is extraordinary, rendering them difficult to kill.

"While hunting at daybreak, I once encountered an unusually large old male Opossum on his way home from a night in the forest. When we met,

[43] Q. N. A., II, p. 110.

[44] As above, p. 116.

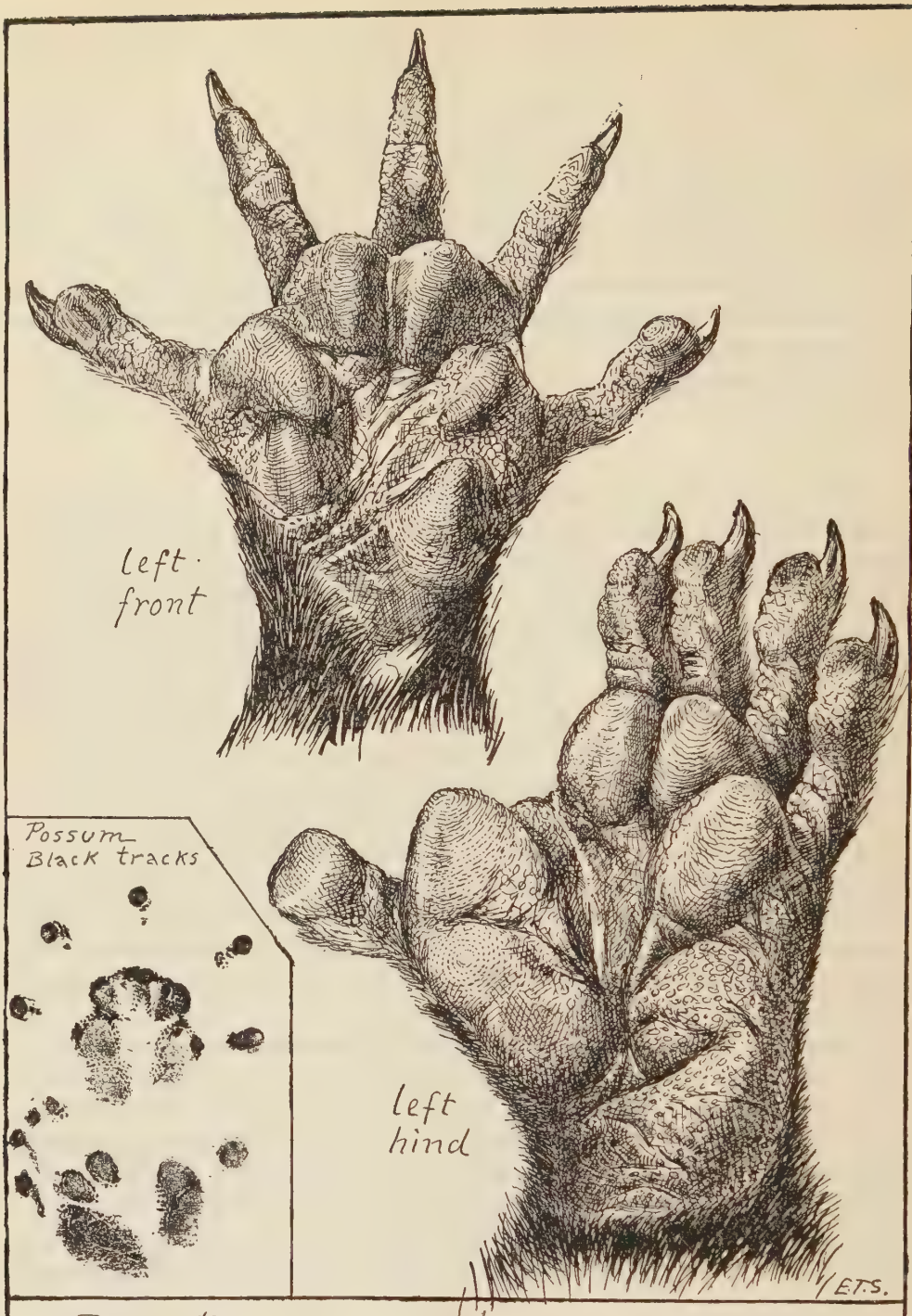

Plate CXII. Paws of Possum nearly twice life size

he immediately stopped and stood with hanging head and tail, and half-closed eyes. I walked up, and, after watching him for several minutes without seeing the slightest movement, put my foot against his side, and gave a slight push. He promptly fell flat, and lay limp and apparently dead. I then raised him, and tried to put him on his feet again, but his legs would no longer support him, and I failed in other tests to obtain the slightest sign of life." [45]

Domestication

It is evidence of servility rather than of brains in an animal, when it submits readily to domestication. Many naturalists have had tame Possums. One of the earliest was Bachman's. He says:

"The Opossum is easily domesticated when captured young. We have, in endeavouring to investigate one of the very extraordinary characteristics of this species, preserved a considerable number in confinement, and our experiments were continued through a succession of years. Their nocturnal habits were in a considerable degree relinquished; and they followed the servants about the premises, becoming troublesome by their familiarity and their mischievous habits. They associated familiarly with a Dog on the premises, which seemed to regard them as necessary appendages of the motley group that constituted the family of brutes in the yard. They devoured all kinds of food: vegetables, boiled rice, hominy, meat both raw and boiled, and the scraps thrown from the kitchen; giving the preference to those that contained any fatty substance." [46]

"On one occasion a brood of young with their mother made their escape, concealed themselves under a stable, and became partially wild; they were in the habit of coming out at night, and eating scraps of food, but we never discovered that they committed any depredations on the poultry or pigeons. They appeared, however, to have effectually driven off the Rats, as during the whole time they were occupants of the stable, we did not observe a single Rat on the premises."[47]

Dr. Charles H. Townsend's tame Possum has furnished a number of interesting facts. Townsend turned the creature loose in his office after commenting on its slow cautious movements, he says:

"Our Possum never exhibited unseemly haste; he had time and to spare. Day after day he crouched on the shelf, as I went on with my noiseless work, but the slightest sound or jar gave him a nervous start: a sneeze or the strik-

[45] Wild Animals of North America, 1918, p. 408.

[46] Q. N. A., II, p. 117.

[47] As above.

ing of a match really disturbed him. His rations, placed on the shelf before him, were at first disregarded, until there was complete silence, when he would be discovered eating with an energy that savoured little of Possum playing. Later on he gained confidence and became tamer.

. . . . . .

"Waiting for a Possum to do something interesting was evidently a matter of more time than I had to spare; so he was swung by the tail on to a shelf near to the window, and just across the room from my desk, where if he ever did anything, I should be a witness. Nothing happened for an hour, when I placed a quarter of an apple under his nose and resumed my work.

"After about 10 minutes, hearing a slight sound, I looked up to see the Possum holding the apple quarter in one hand, and rapidly but thoroughly chewing a mouthful. When the apple was finished, he settled back somewhat on his haunches, and proceeded to wash his face cat-fashion, only he used both hands at once, licking his lips and fingers and then rubbing his nose and cheeks.

"After that, nothing happened for half an hour, when I went over and stroked his back. This caused nervousness and a silly display of his teeth, but he crouched and submitted. No attempt was made to leave the shelf, and in the evening, the Possum was shut in an empty room just to make sure he wouldn't be abroad at night, after the fashion of Possums.

"He was always treated gently, unless carrying by the tail be rough treatment, but the Possum's tail is strong, and is such a safe handle when there are open jaws at the other end of the animal, that there is no other logical method. Besides, he sometimes suspends himself by it."[48]

Food

When one has an omnivorous animal (such as the Possum) in a country of unlimited food supplies (such as America), it is easier to list the foods it refuses than those it accepts. While every bird, beast, reptile, frog, fish, insect, fruit, nut, root, berry, and carrion are accounted "clean" in the Possum's code, it has definite preference for chickens, eggs and persimmons; a definite indifference to Horse and Cow feed, such as hay, oats, and grass; and is rarely known to be guilty of cannibalism.

Bachman is again to the fore as a Possum authority when its food is to be considered. Beginning by saying that the Possum possesses an appetite for nearly everything eatable, he continues, "It enters the cornfields (maize), crawls up the stalks, and sometimes breaks them down in the manner of

[48] Making Friends, p. 23.

the Raccoon, to feed on the young and tender grains; it picks up chestnuts, acorns, chinquapins, and beech nuts, and munches them in the manner of the Bear. We have, on dissection, ascertained that it had devoured blackberries, whortleberries, and wild cherries, and its resort to the persimmon tree is proverbial. It is also insectivorous, and is seen scratching up the leaves in search of worms, and the larvæ of insects, of which it is very fond. In early spring, it lays the vegetable kingdom under contribution for its support; and we have observed it digging up the roots of the small atamasco lily (*Zepherina atamasco*), and the young and tender shoots of the China brier (*Smilax rotundifolia*) as they shoot out of the ground like asparagus.

"It is, moreover, decidedly carnivorous, eating young birds that it may detect on the ground, sucking the eggs in all the partridge, towhee bunting, and other nests it can find in its persevering search. It destroys Mice and other Rodentia, and devours whole broods of young Rabbits, scratching about the nest, and scattering the hair and other materials of which it was composed. We have observed it squatting in the grass and brier thickets in Carolina, which are the common resort of the very abundant Cotton-rat (*Sigmodon hispidum*): and from patches of skin and other mutilated remains, we satisfied ourselves that the Opossum was one among many other species designed by Providence to keep in check the too rapid increase of these troublesome Rats. We must admit that it sometimes makes a sly visit to the poultry house, killing a few of the hens and playing havoc among the eggs. The annoyances of the farmer, however, from this mischievous propensity, are not as great as those sustained from some of the other species: and cannot, for a moment, be compared with the destruction caused by the Weasel, the Mink, or the Skunk."[49]

In Texas, according to Bailey: "They are especially fond of chicken and eggs, and do considerable mischief in the henhouse. They will eat any kind of meat, even when it is old and stale, and often persist in getting into traps baited for more desirable gain. Through the summer, they feed extensively on fruit, and are usually lean and rangy.

. . . . . .

"On the coast prairies of southeastern Texas, they live much in the open, wandering along the margins of ponds and bayous, sleeping under fallen grass or low bushes and feeding extensively on crawfish and other small crustaceans. In the stomach of one taken near Galveston, I found a horned toad and bird's feathers, besides the meat used for trap bait."[50]

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[49] Q. N. A., II, pp. 112–13.

[50] Texas, pp. 56–57.

James H. Gaut "found the stomachs of 2 individuals filled with crawfish, one full of carrion of a dead Hog, and in another traces of maggots and carrion."[51]

These various quotations give definiteness to the previous generalities. The observations on his captive Possum made by Charles H. Townsend, well round out our record of the Possum's tastes, and finish with the surprising suggestion that the Possum may chew the cud.

"In captivity," he says, "the Possum is not difficult to cater for. He eats fresh beef, chipped beef, fish, bread and butter, bread and marmalade, soft gingersnaps, cheese, apples, bananas, slices of orange, and raisins, and is probably as omnivorous as the Dog. He wants water only a couple of times a week, but milk is always acceptable. Drinking is done by lapping.

"Banana tastes good to a Possum, and he masticates it with enjoyment, but a fresh minnow is so delectable that he forgets to be retiring; it wakens him from a pretended nap as nearly instantly as a Possum can waken. It disappears faster than banana, and appeases a deep-seated, primitive hunger in a way that explains why his teeth are of the carnivorous pattern.

"The minnows (plump killifishes a couple of inches long) were seized, well chewed and swallowed, when the Possum settled down for a long period of quiet. His tail relaxed its hold on the end of the shelf, and hung down. Next day a live, flopping, 6-inch roach was laid before him, and was seized instantly. The fish was slippery enough to trouble him, and had finally to be taken by the head. A few minutes after eating it, the nose was stretched forward and elevated, with a rapid chewing and sucking motion of the empty jaws; two quick, forward vibratory motions of the body took place, when the mouth was filled with portions of the swallowed fish, which were long and carefully re-chewed. This performance was repeated a second and third time. It looked like a regurgitation and a chewing of the cud. I have not been able to find any reference to this habit among either carnivorous or pouched animals." [52]

Cannibalism

Cannibalism is crime, according to our definition, because it is a propensity which, indulged in generally, would soon destroy the species that adopts it. I was not a little surprised to find the mild-mannered Possum convicted of gross cannibalism. Here is the testimony:

"A number of years ago," says Leon L. Pray, "5 live Opossums were sent to the Field Museum of Natural History from southern Illinois. In the

[51] Texas, p. 57.

[52] Making Friends, pp. 23–24.

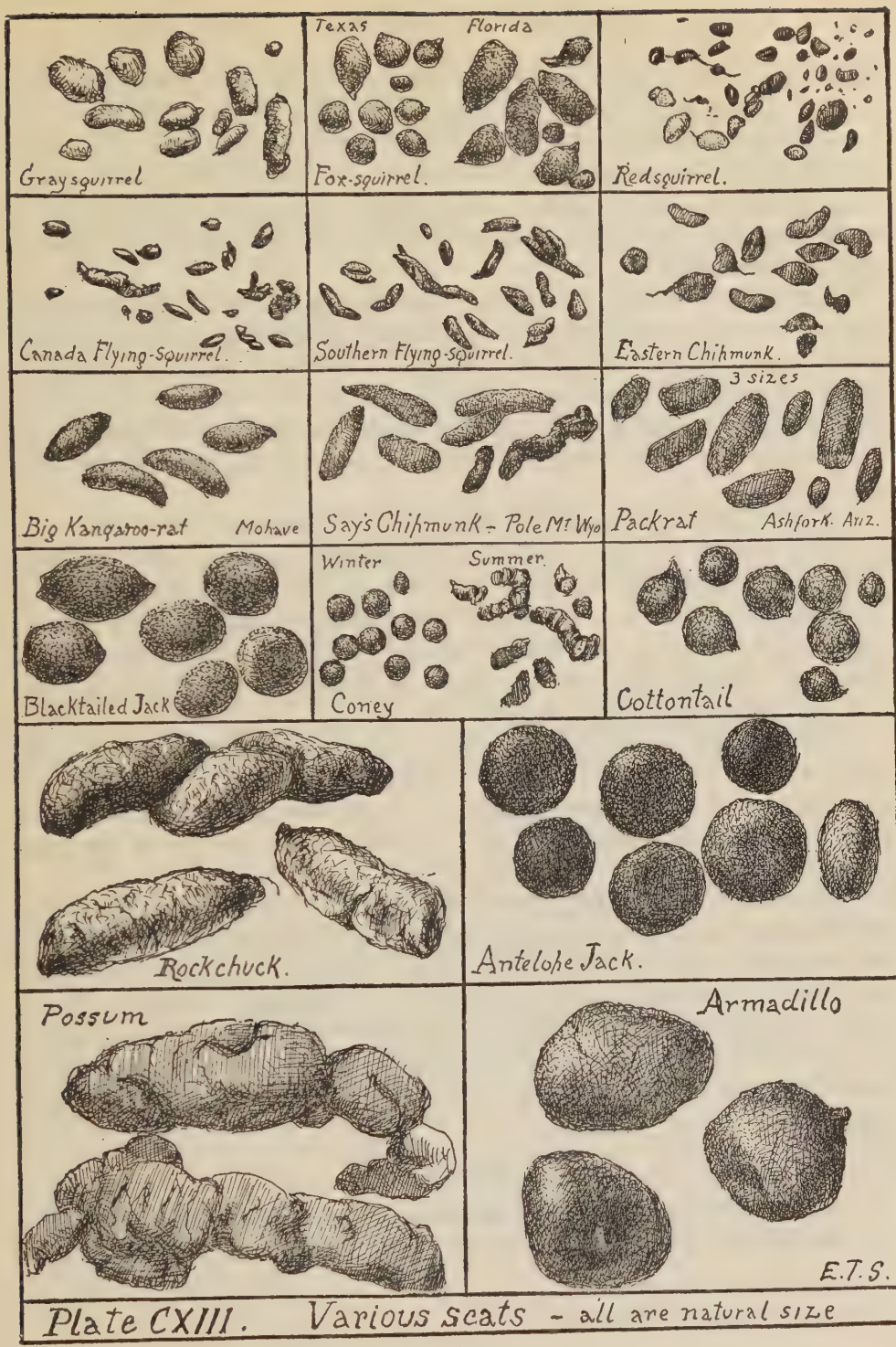

Plate CXIII. Various scats - all are natural size

lot were one nearly grown female and 4 young, not her own, about the size of large House-rats. After arrival, they were kept temporarily in a wire-covered barrel. The second night, the large female literally 'ate alive' one of the young, and afterwards forced her escape from the barrel. She had eaten the hindquarters of the unfortunate youngster without first killing him, as attested by his contorted carcass and awful facial grimace when found cold and stiff next day."[53]

It is doubtless unfair to charge a whole species with crime, because one of its members had manifested criminal mania; especially when that individual was a caged, scared, feverish, and desperate animal. The evidence may be complete, but it does not prove that such a crime would have been committed under normal conditions. Nevertheless, another witness appears, and his testimony is even more completely damning than that of the Field Museum man.

H. C. Bechtel, of Evansville, Ind., was out gunning in snowtime, when he found a large Possum track. This he followed; then, in his own words: "It came together with another Possum track, not as large as the first one. They came together in a V-shape. I followed them until they went over the ridge, and down into a small branch bottom. I then crossed a dry branch, and there, on a smooth, level place, I found the smaller Possum had been killed and most of the best meat eaten off him.

"The smaller track stopped there, and the larger one went on. The snow was all trodden down, and smeared with fresh blood, as if they had fought several rounds of about 10 feet in diameter. The head, lower part of the legs, tail, and bones were all intact, only the best of the meat eaten off.

"I then followed the larger track up a ravine, and found where it branched off to one side, and went into a hole in the side of the hill. I got a spade and with the help of a large Dog who scratched the dirt away as fast as I could dig it loose, it was not long before we had Mr. Possum, and as I was the only witness, judge, and jury, we soon executed him on circumstantial evidence, which was very strong, as there was no other track that came into contact with either one of these two tracks from the place I found them to the end of each."[54]

Enemies

Almost all animals which are good to eat, are protected from countless enemies by their speed, fighting ferocity, armour, barb-wire fences, or poison

[53] Journ. Mamm., May, 1921, p. 109.

[54] Forest & Stream, Aug., 1926, p. 488.

gas, as seen in Rabbits, Weasels, Armadillos, Porcupine, and Skunks. Every one of these things has been denied the Possum.

The host of his innumerable enemies are thus sketchily given by Bachman: "In addition to the incessant war waged against it by men and Dogs, we have ascertained that its chief enemy among rapacious birds is the Virginian owl (*Strix virginiana*) which, flying abroad at the same hour in which the Opossum is on foot, pounces on it and kills it with great ease. We have heard of an instance in which it was seen in the talons of the white-headed eagle (*Haliaetus leucocephalus*), and of two or three in which the great henhawk (*F. borealis*) was observed feeding upon it. We recollect no instance of its having been killed by the Wild-cat or the Fox. The Wolf, it is said, seizes on every Opossum it can find: and we have heard of two instances where half-grown animals of this species were found to have been swallowed by the rattlesnake.

"Although the Dog hunts it so eagerly, yet we have never been able to ascertain that it ever feeds upon its flesh; indeed, we have witnessed the Dog passing by the body of a fresh-killed Opossum, and going off for half a mile farther to feed on some offensive carcase."[55]

And yet the Opossum holds its own. Even man has not reduced its territory, as we have seen. These four things are the strong weapons of its equipment for the life-and-death struggle: It lives in a hole underground, it can climb a tree, it comes out only by night, and it is enormously prolific.

Non-hibernant

The Possum is a lover of warmth and of a snug den, is an underground animal of low organization, and one that gets enormously fat in the fall; therefore, by the rules of parallelism, it should hibernate when cold winter comes on—that is, it should go into a cold-sleep or torpor. Yet there is no evidence that it does. Bachman says: "This animal is far from falling into that state of torpidity to which the Marmots, Jumping-mice, and several other species of quadrupeds are subject. In the Southern States, there are not many clear nights of starlight or moonshine, in which they may not be found roaming about; and although in their farthest northern range, they are seldom seen when the ground is covered with snow, yet we recollect having come upon the track of one in snow a foot deep, in the month of March, in Pennsylvania; we pursued it, and captured the Opossum in its retreat—a hollow tree."[56]

[55] Q. N. A., II, pp. 116–17.

[56] As above, pp. 111–12.

"It is certain," says Mearns, "that the Opossum sometimes roams abroad during cold winter weather. The night of Jan. 13, 1882, was stormy and cold, and the snow lay deep on the ground; as I returned on horseback from visiting a patient, and had nearly reached my house, the Horse suddenly shied at something in the road that proved to be an Opossum. On another occasion, a specimen was killed in a hennery, Jan. 30, 1877."[57]

Referring to those he got in Genesee and Isabella counties, Mich., Norman A. Wood says: "The above specimens were both caught on very severe nights, the thermometer registering 6° F. on Jan. 18 and—12° on Feb. 5. One would expect that the species would not leave a warm home or nest on such nights. The Raccoon certainly does not venture out in winter except when it is quite warm, and it is much more hardy than the Opossum."[58]

How it keeps its slender, naked, widespread toes and unprotected tail from freezing in zero weather, is a puzzle.

Two Possums that I got in Connecticut, including the one from which the pictures were taken, had their ears badly frozen—totally crumpled by the frost indeed, although they had warm dens, and were never exposed to zero weather. Plate CX.

Sanitation

As a sanitationist, the Possum seems not to have developed very far. This remark is prompted by observations on caged specimens.

Yet Townsend says of his captive: "No animal could be more cleanly. After every meal, the forepaws are licked and the face washed. He often licks the fur and hind paws, the latter being used as combs for the hair of the head and sides."[59]

And Bachman records the habit of taking a tonic sunbath, so widely used by animals, and so little, alas, among ourselves.

"We have observed," says this pioneer naturalist, "in this species, a habit which is not uncommon among a few other species of quadrupeds, as we have seen it in the Raccoon and occasionally in the common House-dog—that of lying on its back for hours in the sun, being apparently dozing, and seeming to enjoy this position as a change."[60]

As already noted, the Possum is as near being strictly nocturnal—black nocturnal—as any animal is ever strictly anything; and yet Bachman says: "Although nocturnal in its general habits, [it] is not unfrequently, par-

[57] Fauna Hudson Highlands, Am. Mus. Nat. Hist., Vol. X, Art. XVI, N. Y., Sept. 9, 1898, p. 331.

[58] Notes on Michigan Mammals, 14th Rep. Mich. Acad. Sci., 1912, pp. 163–64.

[59] Making Friends, p. 24.

[60] Q. N. A., II, p. 111.

ticularly in spring and summer, found moving about by day. We have on several occasions met with it in the woods in midday, in places where it was seldom molested."[61]

A similar remark applies to sundry Moles, Gophers, Bats, and other creatures of black darkness, and maybe, in each case, the explanation was the same—they were seeking the blessed, essential purgation of a periodic sunbath.

His Way of Life

Always alone is Possum O'Possum—the fat hermit of the low woods. In the deep, warm den which he made for himself among the long elm roots that defy attempts to dig him out, he has slept all day, quite alone. The sun is gone some time, the shadows of evening have had their little spell; now black night is on the woods. How he knows it, curled up in his black hole, is not easy to say. Perhaps the inner urge of an empty belly it is that sends him forth; and if at the door it seem too soon, he waits. That is all. But sniffing elaborately, twiddling his long whiskers, cocking his thin, skinny ears, he takes in every sound, sense, smell, and vibration that can inform him on the basic questions of foes, friends, or foods in the small world of his possible contacts.

Never far from water is Possum's home; and down to the brookside he waddles in his slow possumic way. First, he takes a drink, then washes his face and hands, combs his hair with his hind feet or front feet, according to which can best reach the spot.

As he strolls along the bank, a scraping, a soft pad-footing catches his ear. He raises his trusty nose and swings to leeward. The sound has ceased; but now, in the black woods, he sees the white face of another Possum. His keen nose assays the wind, and the high vibrations of the incoming message tell him, "Yes, another Possum—and a lady Possum at that." But this is not the mating moon; and she is of no more interest to him than is a bale of hay to a well-fed terrier. So, far from being drawn together, there is positive repulsion between them. She feels her weakness, but shows four threatening rows of teeth—full 50 gleaming points—teeth that an alligator might be proud of—menacing, fierce-looking. But back of their jagged points is no ferocity, and all her threats and warnings are expressed in a feeble hiss. Which matters not at all, for he is indifferent alike to her charm and her menace. He passes on, as a 12-year old "reg'lar feller" passes by a 10-year-old "sissie"—in scornful superiority, to seek his nightly meal.

A few fishworms, misled by the seeming protection of darkness, are

[61] Q. N. A., II, p. 112.

promptly pounced on and gobbled with loud biological sounds that betoken relish. A Meadow mouse glides across his path. He makes an ineffectual, too-slow grab for it—and the Mouse is gone. Beetles of several kinds he mangles with noisy champings of his teeth. Then, as he prowls, his vibrant, supersensitive nose guides him to a seedling apple on the ground—ripe and rotten, for this is summer; but he munches it up with slobbery jaws.

Then, cocking his white face up and aslant, he achieves a thought—a perfect syllogism indeed—and evidences, at first blush, the powers of a profound thinker, were we not compelled to believe that his woodwise nostrils have more to do with it than his wits. He climbs the tree. Yes, here indeed are plenty of little apples, small and tart, but ripe enough for a Possum feast. He fills his belly, and descends to waddle after other adventures.

A sound in the woods makes him stop and cock his ears—heavy footfalls and snapping of twigs. He takes alarm and seeks safety in a shuffling flight to the nearest small tree. But before he can reach its friendly shaft, a huge beast is on him—a Dog. And Possum falls back on the only trick he knows. He lies like dead, "plays Possum," with neither snarl nor threat, nor any attempt to bite his foe. For the Possum is the original pacifist; non-resistance is his creed, and peace-at-any-price, his method. But the Dog has him and gives him a fierce shake. Why the shake should addle the victim's brains and not the Dog's brains, which are equally shaken at the same time and by the same process, is not clear.

It is unpleasant to the Possum to be shaken, but it does not shake his creed. "Lay low and say nuffin" is his slogan; "hang like limp death" his response. Then the Dog, unstimulated to war by the corpse in his jaws, and not a little repelled by the strange, unfoodlike smell of the woolly Pig, drops the body in a sort of triumphant disgust. Now, a foolish Cat, Rabbit, or Rat with ample powers remaining, would seize on this moment of respite to attempt escape. Not so the Possum. Non-resistance in some cases implies non-escaping. He lies like dead.

The Dog goes on to seek for other glories. The silence of the woods is restored. The Possum slyly peeps around—the coast is clear. He waddles in slow haste to the brook, washes his face, combs his hair, rubs his flanks where enemy jaws bruised him—then, little the worse, he crawls home to bed.

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(The author will be grateful for corrections or for details needed to complete this index.)